CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

NEXT MONTH

After more than 10,000 man-miles on a western foray, Editors Kirkpatrick and Manning have returned to their respective desks in New York and San Francisco. Their job now is to compile, condense and interpret their findings into something which they hope *Chem. & Met.* readers will find interesting and informative about developments in the 11 Western States. It will be our fourth regional survey of this great area of nascent technology. Following earlier trails blazed in 1931, 1935 and 1938, it will describe significant progress in electrochemical and electro-metallurgical fields. It will feature natural resources, power, personnel and equipment available to carry the West still further on its path toward a well-rounded chemical economy. Watch for it!

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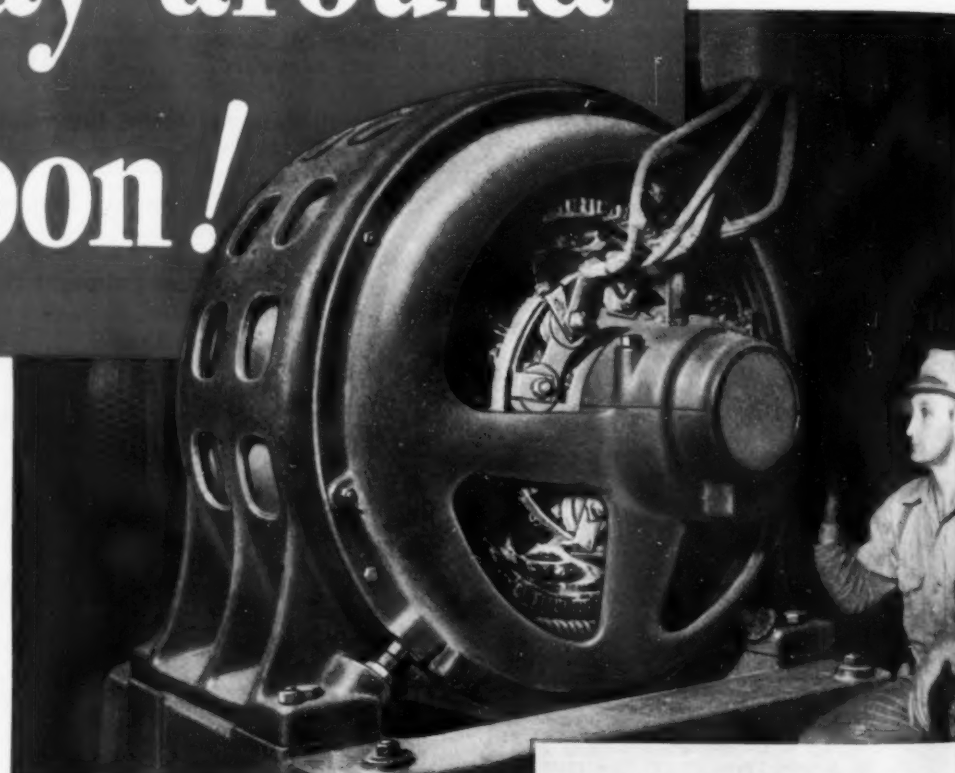

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CHEMICAL
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ENGINEERING

ESTABLISHED 1902

S. D. KIRKPATRICK, *Editor*

AUGUST, 1941

FOR A MORATORIUM ON CONTROVERSIES

AN IMPORTANT JOB in one of the defense agencies is going begging. Two able men—one a chemical engineering teacher and consultant, the other the chief chemist for a large company—were not "available" for this assignment. Why? Each was engaged in preparing expert testimony for a case of patent litigation, which may or may not come to trial within the next year or so.

In more nearly normal times such activities are often valuable and profitable experiences for technically trained men. But today we would be inclined to question their urgency, if not their importance. As laymen, we wonder if it might not be possible to avoid, or at least to postpone "for the duration" some of these expensive legal controversies. Good chemical engineers might thereby be released for more constructive work.

Patent cases are not, by any means, the only controversies that seem to be holding up our defense efforts. Perhaps it is trite to refer to labor problems and the misguided zeal that generates so much friction and strife in industrial relations. Lately we visited a great technical organization where incentive and morale, as well as wages and profits, had been shattered as a result of months of wrangling over the unionization of professional men. Our sympathies were with those who had opposed the efforts of outsiders to regiment chemists and engineers into the ranks of artisans. Yet we could not help but think of how much better it would have been for everybody if men and management could have worked together in avoiding this costly controversy. That one group might have contributed a number of technical advances that are sorely needed now.

In Washington of late we have seen growing evidence of dissension and strife developing within the national defense agencies themselves. Mutual distrust of the motives, on the one hand of the industrialists and on the other of the New Dealers, has led to bitter accusations and time-consuming arguments. Commissions and committees, sections and subsections are being duplicated in opposing camps merely because the absence of plan and authority has promoted controversy as well as confusion. There is not yet any widespread understanding that the national defense is bigger than OPM or OPACS, that neither the Army nor the Navy nor any of their subdivisions is all-important in the present emergency.

Surely there is crying need for unity right now. We cannot afford to waste our time and energy in petty quarrels among ourselves. And most of these differences are silly and inconsequential when compared with the serious responsibilities that the affairs in Europe and the Orient have piled on our shoulders. We've got to build and equip the world's most powerful fighting forces—in the air and on land and sea. We have to back up those forces with the most efficient plants and machinery that we can devise. And, since only relatively few of our people can be in the direct lines of defense, the rest of us have an obligation to carry an even heavier load without complaint or controversy.

Just how it is to be done, we are not sure; but if somehow the President could pronounce a moratorium on controversies, he would release a vast amount of energy, man-power and enthusiasm for the national defense job. Lacking official action, can't we, as individuals, promote personal moratoria that will lead to a more sympathetic, constructive attitude toward problems we all face?

FROM AN

POST-WAR POWER ABUNDANCE

CHEMICAL ENGINEERS will have many readjustment problems to care for when the post-war period finally arrives. Even now it is important to attack some of them in a preliminary way. Fuel and power is one that is going to be extremely important.

From all present indications, the energy supply at that later date will be very great and the energy may be very cheap. Of course, no one can foretell this with certainty. But it looks as though costs well below anything that has yet been experienced by most of the chemical process industries can be expected a few years hence.

Present emergency organization of facilities for the transport of crude petroleum and refinery products will then be supplemented by large-capacity tanker and rail facilities released from military services. The cost of bringing petroleum from both domestic fields and from Latin America should then be very low as compared with any previous experience. Much of the capital cost for ships and pipelines will have been written off. The delivered price of liquid fuels should, therefore, be lower than ever before.

The quantities of natural gas then available will be greater than normal industrial requirement can consume. In the case of this fuel, the transportation costs may be lower than in the past, because here again capital costs will have been largely written off.

There is little need to call attention to the scale of electric-power development now under way and which promises tremendous surpluses after the defense load is no longer a problem. Indications are that this power will be available at reasonable cost.

Imported fuels will be seeking admission to the Eastern seaboard. And it seems not unlikely that large new supplies of Latin American fuel oil will be admitted, possibly without the present excise tax which is virtually a tariff. All these factors will compel bituminous coal producers to do something about their supplies. If they do not do something, they are bound to lose many millions of tons per year of their market. They cannot afford to do this.

All this means that the present changes in energy supply and power generation are bound to require reconsideration in the post-war period, and the bulk of the evidence indicates that relatively very cheap energy can be had by process industries in those later days. This may materially affect present plans for plant location. Certainly it makes emergency substitution of fuel something that should be considered on a tentative and temporary basis, not as a mater of permanent change in raw material supply.

CLOSER COOPERATION NEEDED

TWO GOVERNMENTAL AGENCIES are working on the problem of emergency supply of chemicals and industrial materials. OPM has responsibility for supplies to be used directly in defense projects. OPACS handles the needs of civilians and, as its name implies, the prices to be paid by the public.

There can be no separation of these two projects with respect to most chemicals. Our industries are working with both units and have reason to desire closest cooperation between them. Some day we may have a common defense director who will merge or at least bring these inter-related activities much closer together. Meantime, industry and governmental technical workers must team up to do the common job. There must be cooperation not only between government and industry, but also between these two governmental agencies.

With the good spirit which has existed among the technical men, this matter might not need our comment here. But recent action in the case of chlorine priorities indicates that there may be need for further warning to industry, as well as suggestions to governmental officials. The first announcement about the allocation of chlorine on priority was sound. But it left many industry groups sadly disturbed because there is no clear evidence in the official announcement as to where civilian supply was to come from.

A fragmentary and wholly inadequate news release given to the press was not as widely quoted nor as clearly understood as it should have been. It would have been much more fortunate if the availability of chlorine for water supply and the

EDITORIAL VIEWPOINT

arrangements to care for other essential civilian industries could have been better described. Perhaps it was not necessary to wait for OPACS to finish its job before promulgating OPM findings. But evidence of collaboration between the two was urgently needed when the first part of the program was made public.

Industry need not be unduly critical in these matters. But industry can reasonably ask that no needless "mental anguish" be imposed by partial actions, or actions only partially explained.

NO MONOPOLIES ON PATRIOTISM

ON THESE PAGES in May we explained editorially how arbitrary action of American petroleum refiners might drag the United States into an Oriental war. At that time the industry was being sorely criticized by certain newspapers for continuing to sell oil to Japan. Official Washington remained strangely silent, but on July 24 full official recognition was given to this patriotic cooperation. On that day President Roosevelt made it clear in his press conference that this aid of petroleum companies had been a very necessary part of the effort to keep an extended war from starting in the South Pacific. It is gratifying that the public should have this belated explanation of a situation that only a few technical men understood before this. This may help to convince people that not all types of international trade in chemicals and munitions are so mercenary as glib critics would imply. There is as much patriotism in high industrial places as in high official positions.

A GOOD NAME

NOT SO LONG AGO we saw a summary of the popular opinion expressed by college under-graduates of various important business firms. Students were asked regarding their opinion as to which company was the leader in research work, which had been fairest to its employees, which gave the best service to customers for each dollar spent with it. The answers to these and other questions were very illuminating. Perhaps the most interesting feature was the way in which popular appeal was attached to certain important companies by the students queried. It was obvious that the students knew a lot about certain firms and that they were virtually unacquainted with other equally important, equally aggressive, equally public-spirited enterprises.

We are quite sure that a large group of chemical engineers would have rated many of these firms differently, placing some much higher on their list because they, the engineers, would have an acquaintance which the students did not. And all this seems merely to prove that reputation in a substantial measure depends on the acquaintance of the public with the firm. And this is true whether the public be a group of college students, a group of chemical engineers, or a group of business men.

We like and admire those whom we know best. Stimulation of acquaintance of the public and of professional men with technical enterprises is an important job for both engineer and executive.

BRINGING IT HOME

SCARCITY of chemicals is beginning to be felt in civilian operations to an extent which emphasizes the early impact of defense absorption of available supplies in numerous lines of industry. Shutting off of the air conditioning in a prominent Washington hotel in which many OPM executives live, raised strong protests from these officials. The management told the loudest kicker that he was responsible for their inability to get the refrigerant needed to keep their cooling system going. With the temperature at midnight around 90 deg., it is anticipated that OPM officials will probably find the necessary supply of refrigerant, even if they have to borrow it from OPACS.

EVALD ANDERSON, 1883-1941

EVALD ANDERSON meant a lot to chemical engineering. He was the very center of an organization that has done more than any other to make electrical precipitation such a valuable tool to technology as well as to mankind. From his fertile brain came much of the basic theoretical knowledge that has served as the stable foundation for further technical development and commercial application. For these accomplishments, Anderson was respected, admired and honored. But "Andy" was loved by his friends and associates for his generous character and the great kindliness that always seemed to radiate from his presence. He will be sorely missed.

Chemical Industry Serves Soviet

KARL FALK *Fresno State College, Fresno, Calif.*

Chem. & Met. INTERPRETATION

Chemical industries and their raw materials stand as a critical factor behind Soviet resistance to the German assault as well as a rich prize to lure the Nazis. What are the strengths and weaknesses of this industry? Herein the author, an authority on foreign chemical developments, gives the facts on the Soviet chemical industry as well as the reasons behind these facts.—*Editors.*

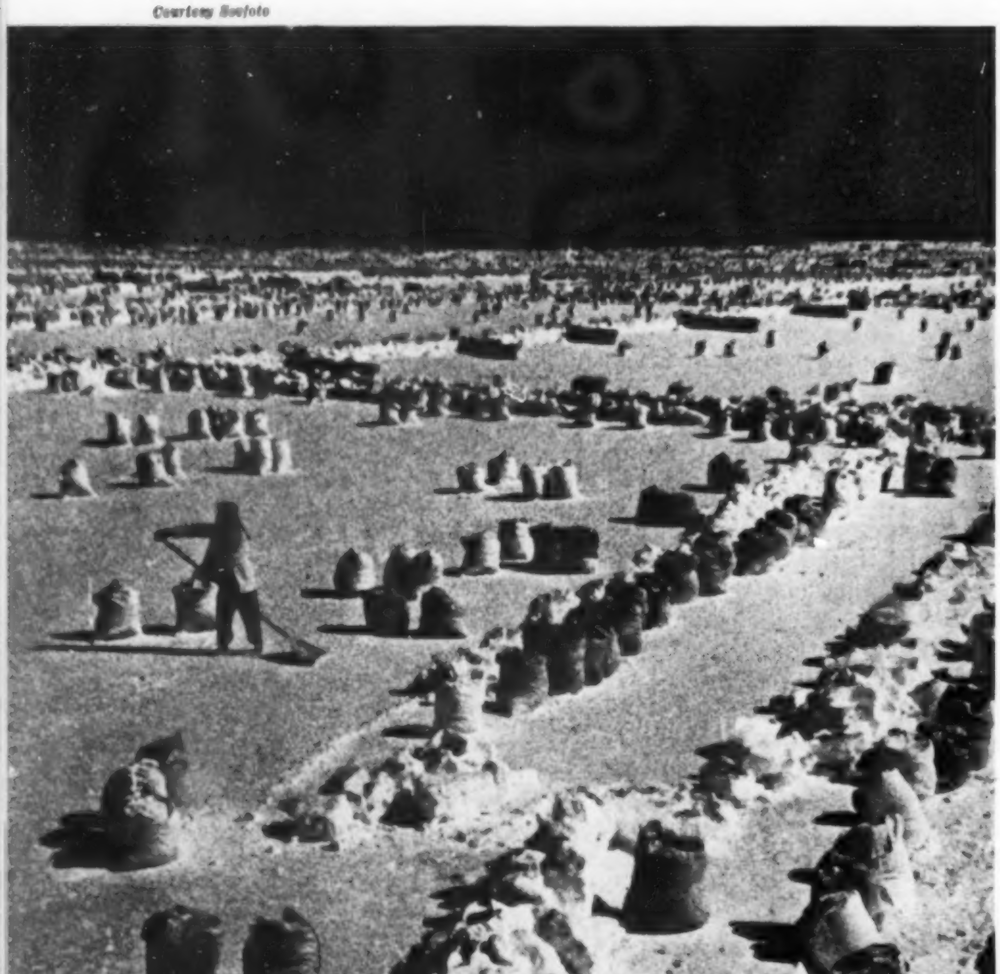
NOW THAT THE GERMAN war machine has turned against the Soviet Union after twenty-two months of uncertain cooperation, an evaluation of the strength and weakness of Soviet industry, especially in the chemical field, is in order. The support which the Soviet chemical industry, the focal point of the Third Five-Year Plan, can give the defending Red armies reflects the progress as well as the difficulties of the Soviet economic experiment and the peculiar geographical and raw material situation of the U.S.S.R. In fact, control of Soviet raw materials is probably one of the Reich's chief reasons for the attack. Unfortunately for Russia, in spite of attempts in recent years to shift industrial and agricultural production centers eastward, the richest areas of White Russia and the Ukraine are those closest to Germanized Europe and therefore most vulnerable to attack.

In Soviet Russia, when figures are published, the chemical industry is understood to include either the narrower field under the Peoples' Commissariat for the Chemical Industry, whose production was valued at 4,300 million rubles in 1940 (5.30 rubles = \$1.00, export value) or the broader field which includes basic chemicals, nitrogen, fertilizers, mining chemistry, ferro-alloys, wood processing, iodine and bromine, aniline dyes, plastics, paint and varnish, natural and synthetic rubber, including the tire industry, and medicinals, glue and gelatine.

Total production of the U.S.S.R. under the latter classification was valued at approximately 8,500 million rubles in 1940, and is scheduled to reach 14,000 million rubles by 1942, the end of the Third Five-Year Plan. So far production is behind schedule in most items. These figures, contrasted with a production of 6,700 million rubles in 1938 and of only 450 million rubles in 1913, are only of relative significance and must be qualified considerably. Tonnage figures provide a more accurate gauge, but even these do not allow for qualitative differences when compared with western European and American standards. Censorship prohibits the publication of detailed figures, since industrial performance has long been considered a military secret.

The U.S.S.R. is not the world's leading producer of any important chemical item, although it is potentially so if certain of its resources become better utilized. Even though Stalin has recently admitted that it may take many years, the Soviet goal is still to become the world's

Courtesy Sovfoto



Vast sodium sulphate fields of the Gulf of Kara-Bogaz-Gol, on the eastern shore of the Caspian sea

et Defense

leading industrial nation. Practically all present chemical production is for defense and home consumption, with the result that the Soviet Union is not yet an important trader on world chemical markets. In 1937, the last year for which figures are available, Soviet chemical exports were only 67 million rubles ($13,-400,000) and imports 33 million rubles ($6,700,000). In the chemical field, Germany, England, and the U.S.A. are the chief suppliers of plants and equipment, especially machine tools and apparatus for petroleum and electrochemical industries as well as of laboratory supplies and equipment.

CHEMICAL PRODUCTION

Leading items in the Soviet's chemical production based on available raw materials are potash and nitrate fertilizers, superphosphates, apatite concentrates, pyrites, sulphuric acid, soda ash, plastics, rubber, wood chemicals, and soaps. The growth of the industry has been phenomenal when one recalls that there were practically no manufacturing plants of any kind in Russia before 1900 and that real industrialization did not even begin until 1928 when pre-war production levels were again reached for the first time. The Soviets were proud of the fact that they made great strides in production during the decade when the rest of the world suffered from the depression. The only modern chemical plant in the U.S.S.R. in 1930 was a nitrate fertilizer plant at Chernorechye.

Strenuous attempts have been made to make the U.S.S.R. independent of foreign sources of materials and to develop industries and raw materials available and needed in the Soviet economy. In each of the three Five-Year Plans (1928–32; 1933–37; 1938–42) many new modern chemical plants were erected in different parts of the country. In the first Plan considerable investments were made in the basic chemical industries. Older plants were modernized, and entirely new industries were set up for the production of such items as aluminum, potash and rayon.

Approximate locations of some of the major mineral deposits, mills and refineries, and chemical plants of European Russia, showing areas of concentration in the Black Sea-Ukraine region, Caucasus mountains in the south and the Ural Mountains bordering Asia

A—aluminum; **C**—coal; **Cr**—chromium; **Cu**—copper; **F** (square)—ferro-alloys; **F** (triangle)—fertilizers; **I**—iron; **L**—lead; **M** (circle)—manganese; **M** (triangle)—miscellaneous; **Mg**—magnesium; **N**—nickel; **O**—oil; **P**—phosphates; **R**—synthetic rubber; **S**—steel; **Z**—zinc

In the second plan (1933–37) emphasis was placed on technological developments, reduction of production costs, and improvements in quality of goods. New nickel, tin and synthetic rubber factories were started. The manufacture of machinery, which has always been one of the difficult problems in Soviet plans, was pushed. Because of lack of experience and productive facilities, machinery and equipment for chemical plants had to be imported, chiefly from Germany and the United States. Installation and operation of these was supervised by German and American engineers until foreign technicians were expelled.

Chemical industry really came into its own under the Third Five-Year Plan (1938–42) which has been expressly designated by Molotov as the "period of chemistry." Chemistry has been given the highest quota of production increase—137 percent—of any Soviet industry for the present period. During the past ten years, 40 percent of total capital investments have been made in key production goods industries, a large share of which means chemicals. It is planned to spend 111,000 million rubles for new plants during this period. Of interest is the fact that money is now being invested in small and middle-sized plants and not in gigantic "show factories".

Soviet industry has tended to neglect integration for bigness, but it is now realized that production records are not worth much unless attention is also paid to quality. Recent measures aimed to improve both quantity and quality of output include raising the "norms" or units of production required for basic pay for factory workers—whose efficiency is estimated to be less than half that of the average worker in the United States and whose pay cannot even begin to be compared—and making factory foremen more responsible for higher quality products. The effort to overcome wastefulness in industry is expressed in the present Plan which is trying for efficient utilization of existing capacity almost as much as it is trying to build new plants. Increasing productivity, better utilization of plants, saving of raw and heating materials, utilization of waste products, and improvement of quality are the professed goals for the chemical industry.

GEOGRAPHICAL DISTRIBUTION

Of great importance for Soviet economy is the geographical location of industries. In spite of strenuous efforts to shift the centers of industrial and agricultural production eastward out of the range of enemy bombers as well as to make Siberia self-sufficient, insufficient capacity has been duplicated or moved to affect vitally the military ability of the Soviet Union to withstand invasion. Although the U.S.S.R. has an area of 8 million sq. mi. occuping one-sixth of the earth's surface and containing one-twelfth of the world's population (170 million in 1939; 200 million including recent conquests), the chief production centers, around which the chemical industry is concentrated, still lie mainly in the southwestern third of the country. The cotton fields of Turkestan and the mineral deposits of the Kuznetsk basin in Siberia are the only important regions outside this area. Half of the Soviet iron and steel production originates in the Ukraine, close to the U.S.S.R.'s richest coal mines in the Donetz basin and the iron ore deposits of Krivoi Rog. Most of the remainder is produced in the Urals, although the eastern Kuznetsk basin is gradually increasing in importance. The Ukraine is the source of most of the Soviet's valuable manganese mines, whose total production reached 3 million tons last year. The Baku, together with the Caucasus Grozny fields, accounted for 85 percent of the 1940 total oil output of 35 million tons (including natural gas).

Lighter industries, including many chemical plants, are similarly concentrated around the three largest Soviet cities, Moscow, Leningrad, and Kiev. Roughly one-third of the larger dye and lacquer factories are located around Leningrad alone. These produce chiefly lithopone, zinc white, ultramarine, and artists' paints. The first synthetic rubber plant was established at Leningrad in 1928. The largest synthetic plant at present, supplying one-third the total production, is at Yaroslavl near Moscow, which is the seat of varied chemical producing and consuming industries.

Other plants, as in the Ukraine and the Urals, are adapted to the local raw materials, as well as to the local needs of the industries. The calcinated soda industry is located chiefly in the Ural and Donetz areas where it is needed, although the lack of raw material in this item has made a shift to the Caucasian-Ukrainian areas (where it is also needed) very difficult. Most Russian plants use the Solvay process, although some are trying other Franco-Soviet processes. In the Baku a plant using sodium sulphate as raw material is being planned. Under the Second Five-Year Plan only 60 percent of soda needs were covered domestically; plans call for a doubling of soda capacity by 1942. Superphosphate, potash, and nitrate fertilizers are also scheduled to be doubled in 1942 as against 1937. The annual 3 million ton output of potash is produced mainly in the middle Ural area at Solikamsk to supply fertilizer needs. At Solikamsk the potash mines have an annual capacity of 2 million tons, but the chemical plant there was able to handle only 1.5 million tons in 1936. Output has probably increased in the meantime, especially with the introduction of flotation processes to treat low-grade ores. The output of phosphate at Kirovsk and Karabugaz is constantly on the increase, with triple superphosphate being produced electrically since 1936 at the former plant. Phosphorite deposits, discovered in 1936 south of Kasachstan, are claimed to compare favorably in quality with those of the United States and in quantity to be equal to the largest in the world.

Production of synthetic nitrogenous fertilizers has been carried out by the original Chernorechye plant and three additional factories at Berezniki, Stalinogorsk, and Gorlovka. More plants are being planned in the Caucasus and central Asia, principally to supply fertilizers for cotton plantations. A new factory established in the Caucasus in 1937 is producing nitrogen as a by-product from coal distillation and from natural gas.

The Soviet claim that about half the world's oil reserves are located in the U.S.S.R., are questioned by American experts. During the past two years, German experts have optimistically cited large figures for the Soviet's raw material reserves as if they were readily available. They have now returned to the pre-1939 critical attitude. Russia has export surpluses of manganese, and is self-sufficient in coal, iron ore, zinc, and chrome, but she must import part of her copper and lead, and nearly all tin, antimony, and the steel-alloying agents—vanadium, molybdenum, and nickel. Copper (1940 production was 157,000 tons) is found mainly in the Kasachstan and Ural areas, and in 1938 about 60,000 tons were imported. About 40,000 tons of lead were imported in 1938. Tin deposits were only discovered recently, and nickel was completely imported before the Third Five-Year Plan started exploiting deposits in the Urals and elsewhere. There is plenty of bauxite for aluminum production found east of Leningrad and in the Urals, and in 1940 about 70,000 tons were produced, with a goal of 150,000 tons being set for 1942. Cheap sources of hydroelectric power and skilled labor are critical factors in this industry.

PETROLEUM SITUATION

The Soviet's ability and willingness to supply oil to Germany during the period of "cooperation" is still largely a matter of speculation. Because of the increased demand for oil at home, the amount available for exports sank from 6 million tons in 1932 to a probable one million tons last year. Mechanization of agriculture as well as increased military needs have put stronger demands on the oil output. That production toward the 54-million-ton goal of 1942 has bogged down is apparent, as last year's production reached only 35 million tons. There were 9,600 oil wells in operation in the U.S.S.R. in 1939. Oil refinery capacity was 33.7 million tons in 1938, while cracking plant capacity was 6.9 million tons. To make local

industries independent of long rail transport for fuel supplies, a new petroleum area, the so-called "second Baku", has been established in the Volga-Ural area. Several new refineries and cracking plants were being installed there by American engineers in 1939-40. It is not known whether German engineers succeeded in bringing them up to western standards of efficiency. Under the Third Five-Year Plan hydrogenation, and coal gasification plants are also being established. Oil shale, of which the Soviet has plenty, is being treated for oil and phenols, and ammonia, acetic acid, carbolic acid, cresol, and higher phenols are being obtained from extensive peat deposits.

Rubber is one of the U.S.S.R.'s most critical materials. Although it had to be completely imported before 1931, it is claimed that by using natural products and synthetics, a high degree of self-sufficiency has now been attained. Guayule shrubs, estimated to yield about 15 grams of rubber per plant, were introduced into Turkmenia from America in 1926. These have not been too successful since they have been very sensitive to frost. By 1942, however, about 20,000 hectares will be planted in guayule. The most successful caoutchouc-type saghyz plant has been the kok-saghyz, a dandelion-like plant which can be raised anywhere in the U.S.S.R. In 1939, 26,000 hectares were planted in kok-saghyz, and by 1942 it is hoped to reach 500,000 hectares.

Synthetic rubber was first produced experimentally in 1928 in the Leningrad plant already mentioned. By 1931 four plants were producing synthetic caoutchouc from alcohol according to the Lebedev process, but since the alcohol was derived from potatoes which were needed for food and since the process is expensive, newer plants are using such methods as the American-Soviet "Sovprene" acetylene process. The Erivan plant, using this process since 1939, plans to expand capacity to 10,000 tons yearly. A third group, using natural gas and petroleum industry residues as raw materials, has a factory in Sungait near Baku. Four synthetic rubber plants were established during the Second Five-Year period and 18 more are called for under the Third Five-Year Plan. That production has been insufficient to meet civilian and military needs is indicated by the recent drastic curtailment of production of rubber shoes and galoshes in order to spare more rubber for tires. Reports on the quality of the tires produced from regenerated, synthetic, and natural rubber are somewhat conflicting, but is it generally assumed that they have been far from satisfactory.

A sharp further increase in production of plastics to replace metals is called for in the Third Five-Year Plan. Synthetic fibres do not yet figure largely in the Soviet chemical picture since emphasis is being placed on increasing natural fibre production.

LABOR ASPECTS

To overcome the shortage in labor supply caused by lack of skilled workers and demands of the army, the working day has recently been lengthened to eight hours in most industries, and the 6-day working week has replaced the former 5-day week. To train younger skilled workers for industry and transport, a recent decree provides vocational training in special schools, provided that in return for the training they will afterward work four years at regular pay in any plant in which they are placed. By June of this year 258,000 skilled workers had been trained in this way, and this is to be expanded to 800,000 per year by the end of 1941. Some 4,065 million rubles have been appropriated in the 1941 budget to carry on these training schools.

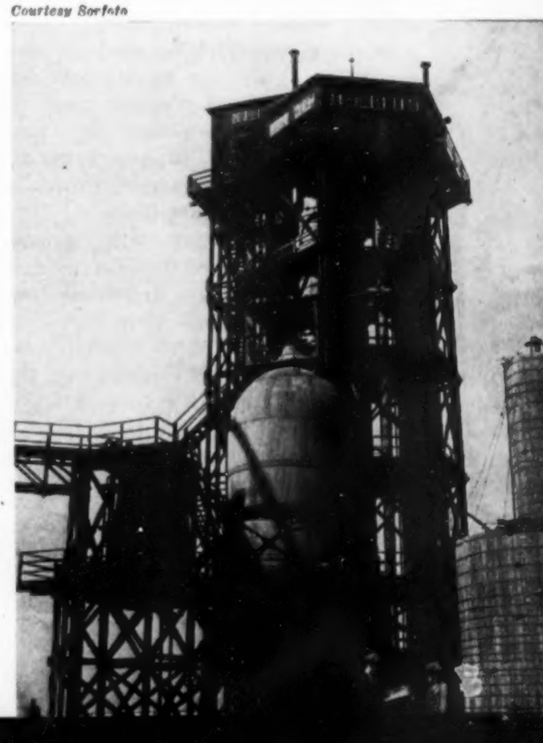
The government is also appropriating 2,299 million rubles for colleges and universities and 1,551 million rubles for technical high schools, which are now being attended by a total of 650,000 students for whom tuition fees have recently been instituted again after years of free schooling. The government has provided generous appropriations for scientific research institutes, 1,032 million rubles in 1941, which will be supplemented by 619 million rubles put up by the industries concerned. These institutes are working on problems of direct industrial importance and are located or have branches in the industrial centers. In the chemical field there are 17 main institutes, some of which have several branches.

As to the calibre of scientific research, the Soviet institutes point with pride to the fact that the number of Russian research works referred to in *Chemical Abstracts* in this country increased from 2.5 percent of the world's total in 1913 to 3.4 percent in 1929, and 11.1 percent in 1939.

To what extent industrial plants are being destroyed by present military operations or sabotage is another factor that will now affect future output. Germans have already intimated that in areas they have occupied they will try to run industries in somewhat the same manner as the French iron and metallurgical plants as well as key industries in other occupied areas. Production is "for the account of the Reich," and operations are taken over by leading German concerns in the respective field. In the last war the Germans controlled the Ukraine and areas as far as Rostov, but transportation difficulties and civilian sabotage made the benefits disappointing. If oil wells should be sabotaged, German engineers familiar with Russian operations could probably have them working again in less than a year. In the case of the Polish campaign in 1939, which lasted only three weeks, oil from southern Polish oil wells was being used as fuel by German armies bombarding Warsaw. If the Nazis push the Soviet army far enough eastward, or if collapse should occur within the Union, the Reich would thereby acquire control of tremendous potential food and raw material sources as well as a good-sized, even though not too smooth-running industrial machine and a new strategic position to withstand the British blockade, probably for a considerable length of time.

Completed in 1938, this Ingur Paper Combinat in the Georgian region uses Caucasian fir and has an annual capacity of 11,700 tons of paper

Courtesy Sovfoto



Plating Relieves Metal Shortages

WILLIAM BLUM *Chemist, National Bureau of Standards, Washington, D. C.*

Chem. & Met. INTERPRETATION

If you have a problem in the protection of equipment against corrosion you will be interested in the comments of this outstanding electrochemist on the methods that might be used during the emergency such as the substitution of silver or lead electroplated coatings. —*Editors.*

THE PRESENT SHORTAGE of certain metals has led to many proposed substitutions. Before the feasibility of such substitutions can be considered, it is necessary to know the relative availability of various metals that might compete with each other for a given purpose. The data in Table 1 may serve as a basis for considering the changes that have been or might be made in the practice of protecting metals against corrosion.

The data bring out many interesting relations. The small production of bismuth may be an evidence not so much of its scarcity as of lack of demand. The ratio of about 400 to 1 for production of zinc to cadmium shows the futility of attempting to substitute cadmium for zinc in coatings. On the other hand, the small ratio of about 12 to 1 of nickel to silver justifies consideration of silver in place of nickel for certain coatings, even with the twenty-fold difference in price. Though more tin than nickel is produced, and both must be imported, the supply of tin is more likely to be interrupted by any extension of hostilities.

It is significant that the greatly increased demands for metals have resulted in shortages and consequent priority restrictions upon numerous metals, some of which are normally exported from this country. In this entire list of metals, only gold, silver, bismuth and lead may be considered as relatively plentiful, i.e., free from restrictions on usage. Any such distinction may be very temporary. Practically speaking, all the metals are now scarce and their applications must rest on their relative scarcity in the light of defense demands and conditions.

One of the chief reasons for coating one metal with another is to obtain surfaces with the properties of the coating metal by applying a relatively small proportion of that metal. Hence it is not surprising that, of the total production of a given metal, the proportion that is used in coatings is relatively small. Table 2 contains values for the normal consumption in the United States of metals in coatings. Some of these values are rough approximations, that are believed to be right in the order of magnitude only.

METAL CONSUMED IN PLATING

It appears that the proportions of only nickel, silver and cadmium that are used in electroplating are sufficient to have any significant effects upon their availability for other purposes. Large quantities of zinc and tin are normally applied by hot-dipping. Substitution of electroplated zinc and tin coatings warrants consideration, because the thickness may be more readily controlled by plating and metal thereby conserved. In the bethanizing process, zinc is deposited directly from an extract of the ore, and is therefore not in direct competition with other uses of the metal zinc. The zinc dust used in sherardizing is a byproduct that is not readily convertible into solid zinc.

The proportion of chromium used in plating is almost negligible. As the chromic acid is produced from low grade ores that are not usable for making ferro alloys, chromium plating does not compete directly with the chromium alloys.

Of the three metals used extensively in plating, silver is available, and cadmium is not in great demand for other purposes. Nickel plating has been severely curtailed because of the demand for nickel in alloy steels. At present (July, 1941) the allocation of nickel anodes to be used for non-defense plating is only 30 percent of their normal consumption.

The most direct effects of metal shortages are seen in the substitution of one metal for another in the construction of articles for both defense and civilian needs. Because there is a greater present and potential supply of steel, it is largely replacing non-ferrous metals, including aluminum, zinc die-castings, brass, and nickel-brass (or nickel-silver), and also stainless steel. These substitutions nearly always necessitate appropriate coatings to protect the steel.

Until recently, because copper was more available than zinc, copper-rich alloys were recommended. Now the situation is reversed and the use of copper is more curtailed than that of zinc.

Lead alloys have been suggested to replace zinc die-castings, but have found only limited uses, partly because they lack the required strength.

The most important change in electroplated coatings has been the substitution of copper for a large part of the nickel used in plating steel, especially in the automobile industry. Extensive exposure tests have shown that in thin coatings, e.g. up to 0.0005 in., copper does not have as much protective value as nickel. In thicker coatings, such as 0.001 in., especially if the copper layer is buffed, it is practically equivalent to nickel.

Summary of paper entitled Effects of Metal Shortages Upon the Protection of Metals With Metallic Coatings presented before the A.A.A.S. Research Conference on Corrosion at Gibson Island, Md., Aug. 5, 1941.

The application of chromium over copper on steel, i.e. entire elimination of the nickel, is frequently suggested. Exposure tests of plated coatings on copper and brass show that chromium coatings alone furnish little protection against corrosion, and that at least 0.0001 to 0.0002 in. of nickel is required to protect copper or brass. Therefore, in plating over copper on steel at least that thickness of nickel should be applied prior to the chromium.

The shortage of zinc has led to suggestions that cadmium coatings be substituted for zinc. The small production of cadmium and the increased demands for cadmium plating on parts of aircraft and of projectiles make the reverse substitution, i.e. of zinc for cadmium, much more logical.

The greater availability of lead justifies its substitution for zinc or cadmium for coatings on steel, especially in industrial exposures. Hot-dipped lead coatings usually include 15 to 30 percent of tin, in terne plate. The potential shortage of tin suggests the use of electroplated coatings of pure lead. Deposited lead-tin alloys are preferable, however, when the plated parts must be soldered.

The substitution of silver for nickel or tin, especially on food utensils warrants careful consideration. The recent researches of the American Silver Producers have shown that satisfactory impervious coatings of silver can be applied to steel. The required thickness of the silver can be reduced by substituting copper for a part of the silver. One objection to the silver coatings is that they tarnish more readily than does chromium or nickel. The silver can be chromium-plated, but not so readily as can nickel.

Consideration of the rare or unusual metals shows that none of them has both the availability and properties to warrant extensive substitutions, though they may find specific applications. Cobalt is like nickel, but less available and equally in demand. Deposited tungsten alloy coatings may replace solid tungsten alloys for special purposes. Indium is being deposited on and alloyed with lead on aircraft bearings. Gold and the platinum metals may find more extensive use in industrial coatings.

NICKEL PLATING

In nickel plating the use of insoluble anodes has been tried with fair success. At first thought it might appear that the nickel could then be plated from nickel salts, especially nickel sulphate. This salt is produced chiefly as a byproduct of copper refining, with a total production equivalent to about 1 percent of the total nickel produced. In present practice, the nickel sulphate consumed in plating is lost in "drag out" of the solution that adheres to the plated articles. Much of this could be saved, especially in large installations, by the use of "standing" rinse tanks, whose contents are returned to the plating tanks.

Even if nickel sulphate is thus recovered, it cannot directly replace the nickel that is deposited. Some basic compound such as nickel carbonate must be added to replace the nickel and to neutralize the acid set free in deposition with insoluble anodes. Fortunately, nickel carbonate can be made cheaply by adding sodium carbonate to the purified nickel salt solution, from which nickel sulphate would normally be crystallized. The use of well buffered plating solutions does not decrease the consumption of nickel carbonate, but it may reduce the frequency of its addition to keep the pH between desired limits.

There are several practical difficulties in the use of insoluble anodes in nickel plating. The chloride content of the bath must be reduced to prevent the attack of the lead or graphite anodes and the evolution of chlorine, with consequent need for ventilation. Lead anodes appear most practical. The organic compounds used as brighteners in modern baths are likely to be oxidized at the insoluble anodes.

The present extensive use of bright nickel plating baths is advantageous, because buffing of the plain nickel deposits causes a loss of nickel and a reduction in the thickness and protective value of the coatings.

In the present emergency, especially if prices of metals are controlled, the justification for the substitution of a metal or a coating must be found, not in a saving of money, but in a saving of some strategic metal. In other words, aluminum, copper, zinc and steel are now more "valuable" than the gold and silver used as a monetary basis. In meeting the new conditions, it is necessary to bear in mind that an expenditure of a small amount of one relatively scarce metal may result in a saving of a much larger amount of another equally important metal.

The defense needs for coated metals can apparently be met with available materials with no serious sacrifice of quality. Electroplated coatings on steel may prove valuable and economical, by permitting substitution of plated steel for metals needed for other purposes. Electroplated coatings of zinc and tin may replace thicker coatings produced by hot dipping.

The author desires to express his appreciation for information and advice received from numerous government officials, especially E. W. Pehrson of the U. S. Bureau of Mines and D. A. Uebelacker of the Office of Production Management.

Table 1—Normal World Production of Metals.

(Based on 1939 Values in 1940 Minerals Yearbook[1]).

Metal	Annual Production short tons	Ratio of Production	cents/lb	dollars/ton	Total Value Million Dollars	Ratio of Value
Gold	1,300	*1*	($35 oz)	1,000,000	1,300	325
Bismuth	1,500	1.2	125	2,500	4	*1*
Vanadium	3,000	2.3	300	6,000	18	4.5
Cadmium	4,200	3	65	1,300	5	1.2
Cobalt	6,000	5	150	3,000	18	4.5
Silver	10,000	8	45 (oz)	13,500	135	34
Tungsten	15,000	12	200	4,000	60	15
Molybdenum	17,000	13	100	2,000	34	8
Antimony	32,000	25	12	240	8	2
Magnesium [3]	33,000	25	30	600	20	5
Nickel	120,000	90	35	700	84	17
Tin	195,000	150	50	1,000	195	50
Chromium [2]	200,000	150	20	400	80	20
Aluminum [3]	735,000	550	20	400	300	75
Zinc	1,800,000	1,400	5	100	180	45
Lead	1,700,000	1,300	3	60	100	20
Manganese	2,000,000	1,500	7.5	150	300	75
Copper	2,000,000	1,500	11	220	440	110
Iron	110,000,000	85,000	1	20	2,200	550

[1] In some cases data are based on 1938 production. [2] Based on approximate uses of the ores. Prices of several of the metals are based on their cost in the form of commercial ferro-alloys. [3] U. S. production of aluminum and magnesium has increased in the last two years by two- and five-fold respectively.

Table 2—Approximate Percentage of Total U. S. Consumption Normally Applied in Metal Coatings.

Metal	Electroplating	Hot Dipping	Sherardizing
Lead	0.01	1	
Copper	0.1		
Zinc	1	40	0.1
Tin	1	40	
Chromium	1		
Nickel	7		
Silver	10		
Cadmium	50		

Two steps in fluorescent lamp manufacture at the Bloomfield plant: at left, coating the inside of a tube with a phosphor-lacquer mixture; at right, aging lamps for a few minutes to insure proper operation

Chemicals in Fluorescent Lamps

J. W. MARDEN *Research Dept., Westinghouse Electric & Manufacturing Co., Bloomfield, N. J.*

Chem. & Met. INTERPRETATION

Although they represent a fundamental advance in lighting, giving three times as much light for the wattage consumed as older type tungsten filament lamps, fluorescent lamps have penetrated far into industrial and commercial lighting, with hardly a ripple of surprise on the part of the general public. This new lighting method means a considerable market for chemicals, as well as glass. Dr. Marden explains why the various chemicals are used, what results are produced by impurities, and ventures a guess of future needs.—*Editors.*

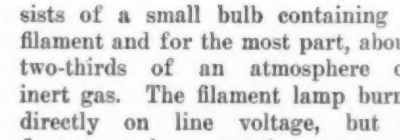
Tremendous improvements in such devices as the automobile, or the astonishing growth of radio in the last 20 years, have caused the public to accept startling new developments as something to be expected, with little or no element of surprise.

The introduction of fluorescent lighting into stores and display rooms is another case and is taking place without most people realizing that the color effects produced cannot be obtained efficiently in any other way; or that fluorescent lamps give three times as much light for the wattage consumed by the lamp, as the older type tungsten filament lamps.

The development of fluorescent lamps has required the production and purification of special chemicals to be used in their manufacture. In a general way, a filament lamp consists of a small bulb containing a filament and for the most part, about two-thirds of an atmosphere of inert gas. The filament lamp burns directly on line voltage, but a fluorescent lamp requires a transformer, choke coil or other auxiliary equipment for maintaining the proper voltage of operation.

Fluorescent lamps are relatively long tubes containing electrodes at the ends (which may be oxide coated tungsten filaments or cold electrodes like those used in neon sign lamps), a low pressure of inert gas, a few droplets of mercury and a coating of material which will absorb the resonance line of a low pressure mercury discharge in the ultraviolet at 2,537 Angstrom units and reradiate this energy in the visible part of the spectrum.*

*Editor's Note—A simple form of fluorescent lamp is diagrammed herewith. At either end of the glass tube (which is internally coated with fluorescent material) is a tungsten wire filament coated with an electron-emitting oxide. The lamp is wired as shown, with the 110-volt line at *L*, a choke coil to limit the current flow at *C*, and a starting switch at *S*. When the starting switch is closed momentarily, the tungsten filaments are heated, giving off electrons and ionizing the argon and mercury vapor and starting the mercury vapor arc. Switch *S* can then be opened and the lamp will continue to operate.



CHEMICALS USED

Following is a general list of the chemical compounds used in the United States in producing fluorescent lamps. There has been no attempt to assign an exact formula to these compounds because of the fact that many of them may be varied considerably in ratio of negative to positive radicals, either for efficiency or color purposes.

Electrodes	Tungsten filament for hot electrodes; nickel or other metal cups for cold electrodes; BaO, SrO, or CaO for electron emitting coating on the electrode.	
Gases	Rare gas, usually argon; mercury.	
Fluorescent Compounds	ZnO SiO_2	green
	CdO SiO_2	pink
	CdO B_2O_3	pink
	ZnO B_2O_3	pink
	MgO WO_3	white
	CaO WO_3	blue
	ZnO BeO SiO_2	white
Activators	MnO PbO ThO_2,	etc.
Binders	Nitrocellulose, solvents, etc.	

Electrodes—In a fluorescent tube before the discharge is started the gas is in the un-ionized condition and in order that current may flow through the tube, the gas must be excited and maintained in this condition during operation. Mercury vapor atoms must be bombarded by electrons having several electron volts velocity to excite them. The passage of electricity through a gas (as with a fluid in electrochemistry) consists essentially of the passage of electrons by a sort of bucket brigade process and these electrons must be drawn from the cathode (the negative electrode). About 6 to 10 volts is required to accelerate electrons at the cathode to give them sufficient velocity; and several volts is also consumed at the anode so that about a 12- to 17-volt drop occurs at the two electrodes which is not used in the discharge to produce light. Thus lamps having a 60-volt drop have about 25 percent of the energy lost at the electrodes.

In order to make low voltage lamps as efficient as possible, a size of tungsten filament is selected which, at the discharge current used, will run red hot and these filaments are coated with BaO and SrO in order that only a relatively low voltage is required at the cathode to maintain a discharge. This coating material is similar to the oxide coating used for high electron emission in radio tubes.

Cold (cup type) metal electrodes are used in low-current, high-voltage fluorescent lamps. The metals used by manufacturers of this type are nickel, iron, copper, nichrome, etc. Here the cathode drop may be about 100 volts and the lamps operate at several hundred or thousand volts, so that oxide activation is not always needed to give high efficiency.

Gases—In an aqueous solution, a salt is ionized so that conduction starts at a low voltage. In a gas, however, a higher voltage is required to "break the gas down." When a rare gas is used with mercury, starting of a lamp is greatly facilitated. Usually a pressure of about 4 mm. of argon is used in fluorescent lamps.

This rare gas also has other functions such as protecting the cathode. If no gas is present, excited mercury atoms or ions which are positively charged may strike the cathode with sufficient velocity to knock off particles of the cathode. This is known as sputtering and results in blackening the ends of the lamps and destruction of the cathode. The rare gas at moderate pressure (such as 4 mm.) also greatly adds to the stability of operation of the lamp.

Mercury vapor is required in the lamp at a pressure of a few thousandths of a millimeter to give a maximum amount of energy at 2,537 A. The fluorescent powders are designed to give the best possible fluorescent response to ultraviolet at this wave length. Fluorescent lamps are generally built to give the proper temperature to produce the desired mercury pressure when operated in air at room temperature. Since the ionization and excitation potentials of mercury are lower than those of argon, only the lines of mercury appear in the discharge, even though the mercury pressure is only one-thousandth as great as that of the argon.

Fluorescent Compounds — Many hundreds of chemical compounds fluoresce but only a few are suitable for use in lamps. The function of these compounds is to absorb the one radiation in the ultraviolet at 2,537 A which can be efficiently produced with the mercury discharge, and efficiently to re-radiate this energy in a desirable portion of the visible spectrum. Many compounds respond only weakly to the proper wave length of ultraviolet or they do not re-radiate the energy efficiently.

Fluorescent compounds for lamps must be chemically very stable. The chemist ordinarily thinks of mercury as an inactive metal near the bottom of the electromotive series, not displacing hydrogen or alkali metals. Mercury in the excited condition in a discharge, however, is exceedingly active, chemically. It is known, for example, that excited mercury vapor readily decomposes carbon dioxide gas at room temperature. Experiments with various materials on the inner walls of a tube containing a mercury discharge show that substances like sodium chloride, free boric acid and even water vapor are readily decomposed by excited mercury atoms. It becomes at once apparent in the light of this that compounds used inside fluorescent lamps must have great chemical stability.

Zinc or cadmium sulphides are used in fluorescent paints employed for stage effects but do not have sufficient chemical stability to use inside of lamps.

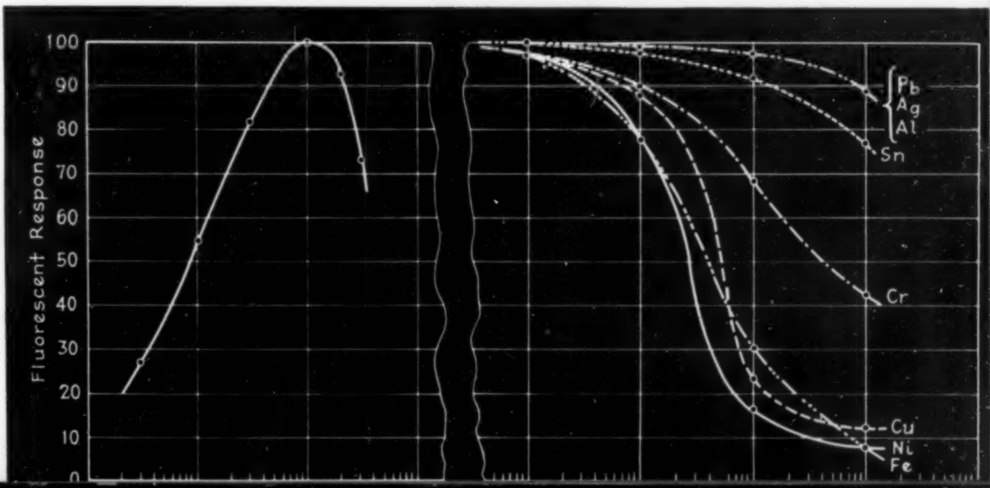
EFFECTS OF IMPURITIES

According to modern theories of atomic structure, the positive nucleus is surrounded by electrons having various energy levels that require different amounts of energy for the displacement of electrons from one relative position to another. In some compounds, electrons may be so placed, and acted upon by the vari-

(Please turn to page 84)

Fig. 1. Left—Effect of manganese on zinc silicate

Fig. 2. Right—Effect of various impurities on zinc silicate



Operations Begin at Fairmont Fluorescent Lamp Plant

EDITORIAL STAFF

Chem. & Met. INTERPRETATION

To supplement Dr. Marden's interesting article on chemicals used in fluorescent lighting equipment (pp. 80-81), a *Chem. & Met.* editor visited the mammoth new Westinghouse fluorescent lamp plant at Fairmont, W. Va., shortly before operations commenced on August 2. The new plant is a striking example of modern industrial architectural trends, featuring windowless construction, broad spans, tremendous working area under one roof, fluorescent lighting at high intensity, and complete air conditioning. Although it is casually described as a "blackout" plant, this type of construction was employed for process reasons, not for air raid protection.—*Editors.*

Situated at Fairmont, W. Va., where an ample supply of female labor of the type needed in fluorescent lamp manufacture is available, and where other necessary features such as good transportation facilities, ample electric power and natural gas are also to be had, the new plant just completed by Westinghouse Lamp Co. for the manufacture of fluorescent lamps is an excellent example of modern functional factory design. Capacity of the present plant, when the new crew of operatives has been broken in, is expected to reach 50,000 lamps per day. Eventual capacity may be as high as 200,000 lamps. In addition to the lamp plant (a $3,000,000 investment which is now practically completed), Westinghouse contemplates construction at this same site of a $1,800,000 glass factory to make use of the excellent natural gas and glass sand supplies available at Fairmont. This new glass factory, which will be completed in May 1942, represents the first excursion of the Westinghouse organization into glass production.

The new glass plant, which will eventually employ 400 people, will make use of three large glass-making furnaces estimated to have a capacity of some 8,000 tons of sand per year. The building, which will be 355 ft. long and 240 ft. wide, will include glass-making machinery for the 1-in. and 1½-in. tubes used for fluorescent lamps, as well as small glass tubing for miniature lamps. Total glass output will be in excess of 6,000,000 lb. per year.

The 90-acre site on which the new fluorescent lamp plant is located is situated a short distance out of Fairmont on a spur of the Baltimore & Ohio Railroad. Three sidings are available at the plant. Preparing the site for building represented a complex problem in that the ground slopes considerably toward the Monongahela River and was originally cut by two deep ravines, requiring the handling of some 260,000 cu. yd. of material in the grading, varying from hard rock to soft clay. The finished grade is on three levels. The new glass plant will be situated on the highest level, feeding downward to the fluorescent lamp plant on the second level. On the lowest level is a personnel building, parking lot, plant entrance and facilities for getting employees into and out of the plant. Space is available for considerable expansion in the future.

BUILDING DESIGN

At present the plant comprises one main building of almost 5 acres extent, 885 ft. long and 224 ft. wide, and seven small supplementary buildings. The main building is constructed with brick and hollow-tile walls, floored with a 5-in. concrete slab (which is topped with various materials, depending on requirements in the various areas) and roofed with a 3-in. poured gypsum slab, surfaced with built-up roofing. Since most of the plant is air conditioned, the need for the good insulating qualities of this construction can readily be appreciated.

The building is almost entirely windowless, not because the blackout feature of this type of building was considered essential, but because absolute freedom from dust is necessary in the process. Zone-controlled air conditioning is provided for most of the main building area, except in the shipping and receiving departments. The air conditioning installation is an interesting one, owing to the fortuitous circumstance that the plant is situated above an abandoned coal mine flooded with water which varies hardly at all from a temperature of 55 deg. F. throughout the year. Water is drawn from this mine at the rate of 3,600 g.p.m. and circulated around copper coils through which city water is passed. The cooled city water then circulates over the air conditioning equipment. The mine water, having been increased 8 to 10 deg. F. in temperature, is returned to the mine at a point about 1,000 ft. distant from the intake.

The necessity for avoiding all dust in the factory led to other features of the air conditioning and building design. All entrances to the plant are through corridors with normally closed doors at each end, protected by air curtains. The parking area is topped with asphalt emulsion to avoid bringing in dust on shoes. All air is cleaned with Westinghouse Precipitrons which remove about 90 percent of the dust. As an additional air conditioning factor, for the safety of the employees, air in all ducts is irradiated by a total of 600 Sterilamps for the purpose of destroying bacteria and other micro-organisms. All air conditioning equipment and ducts are supported from the roof trusses, as are process lines and the low-voltage electrical distribution system.

A feature of the plant is its use of fluorescent lighting in all areas except for outdoor yard protection, where flood lamps are used. In the manufacturing area continuous reflectors traverse the building at heights from 10 to 13 ft., spaced on 12 ft., 3 in. centers. Installed in these reflectors are double rows of 40-watt fluorescent lamps, capable of giving an intensity of illumination of 40 foot-candles at the working level. In event of power failure, emergency lights are provided, connected to the regular city lighting-power supply lines. In addition, an engine-driven emergency generator is available for immediate action,

should both the plant power supply and the emergency city line fail.

Fluorescent lamp manufacture consists in the assembly of the electrodes, the interior coating of the lamp tubes with phosphor powders such as are described in Dr. Marden's article (pp. 80–81, this issue), the attachment of the electrodes at the two ends of the lamp tubes, and the attachment of two-pronged bases at the ends of the lamps. In addition to several sizes of glass tubing, the raw materials include the phosphor powders (prepared at the company's Bloomfield, N. J., plant); copper, nickel and tungsten wire; oxygen, hydrogen, argon, natural gas and mercury; and electron emission materials for coating the electrodes. Nitrocellulose lacquers and solvents are required for the preparation of the tube coating material.

Oxygen comes to the plant in liquid form but is unloaded as a gas and stored under pressure in an oxygen building containing 240 permanently mounted cylinders which are piped by underground lines to the lamp plant. In a second small building, argon and hydrogen are stored in the cylinders in which they are received, being connected by manifolds and pipelines to the lamp-making machines. Lacquer is stored in still a third building, together with solvents. These materials are transported to the lamp plant as needed by railroad handcar. In all three of these buildings, vapor-proof lighting fixtures are used while the lacquer building is further protected by sprinklers. Powders required in lamp manufacture are received from the Bloomfield plant, properly prepared for use, and are stored in the main manufacturing building.

In automobile industry terms, manufacture consists of two principal "sub-assemblies" and a main assembly. The first of these is the electrode. Short lengths of glass tubing of proper diameter are heated and flared to a horn shape and then transported to rotary machines on which the first operations of electrode assembly are carried out. The flared piece is placed over a jig in which the operator assembles the small diameter glass exhaust tube, flanked on either side by the electrode wires. The latter are a composite of copper lead wire, short nickel section for fusing in the glass, and tungsten inner section. The machine rotates the assembly between oxygen-natural gas burners, where the small end of the flare fuses around the two electrodes and to the exhaust tube. The machine automatically blows open the collapsed exhaust tube and finally cools the part for ready removal.

The assembly then goes to an operator who spot-welds the tungsten filament to the two electrodes in an atmosphere of hydrogen. Another operator dips the filament in a mixture containing the electron-emitting oxide and the assembly is then passed to a work-station where an electrical connection is made through the filament to burn off excess coating material. After inspection, the electrode assembly travels to the final lamp assembly department.

Glass tubes for manufacturing the fluorescent lamp bodies are used in 1-in. and 1½-in. diameters, in lengths from 15 to 48 in. As received from the tubing manufacturer the tubes contain a certain amount of dust which must be removed carefully to avoid spots in the finished lamp. This is accomplished on a specially designed flat-bed brushing machine which brushes the insides of six tubes simultaneously. The tubes are supported horizontally and the brushes pushed through while a current of air is being drawn through the tube. In this department the manufacturer's name and the lamp rating are etched on each tube. The tubes are then stacked in carriers and wheeled to the coating department.

COATING OPERATIONS

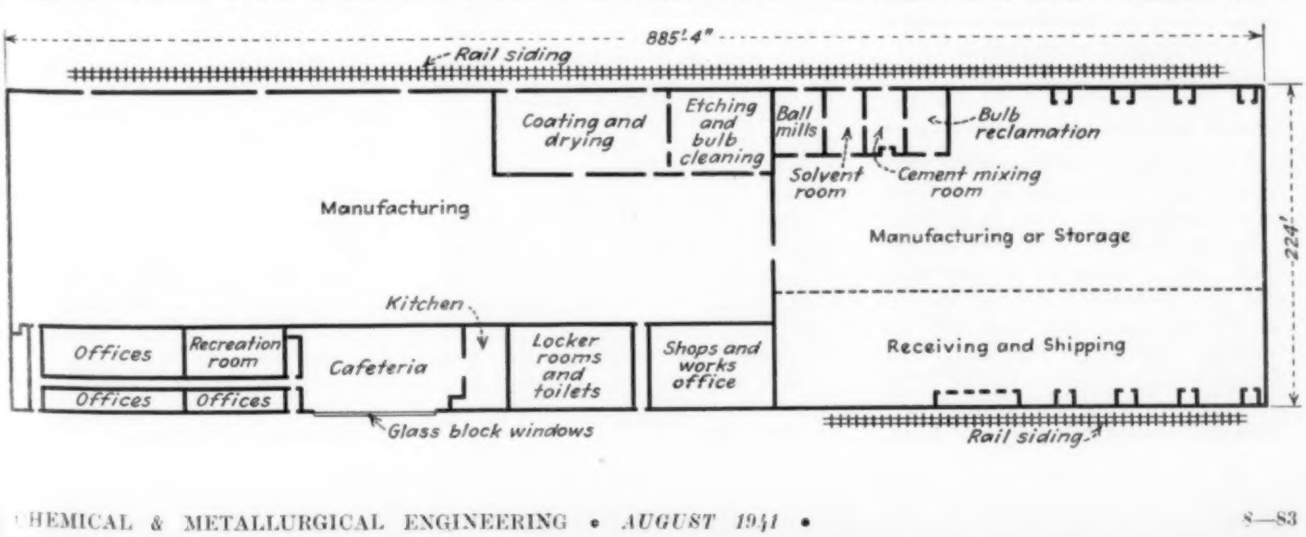
Lamp coatings are prepared in a number of 50-gal. ball mills in which the mixture of fluorescent powders and activators is ground with flint pebbles in a mixture of nitrocellulose lacquer and solvents. After a homogeneous mixture is obtained, a 1-gal. sample is withdrawn from the ball mill and is used to coat six lamp tubes which are then sent through the entire process, finally emerging as completed lamps which are fully tested for color and performance. Only after the batch has thus been shown to be up to standard is it released for manufacturing. If it is not, it is corrected in the ball mill and retested by the production of six more lamps. As needed, the lacquer mixture is transported to the coating and drying room where the tubes are coated internally with newly designed automatic machinery.

The earlier method of coating was to support the tube vertically over a jet and employ air pressure, controlled by the operator's finger over a nozzle, to force the lacquer mixture up into the tube. In this operation, both filling and emptying time are critical in producing the desired thickness and uniformity of coating, assuming that the lacquer is of correct viscosity. In the new automatic machine, the work is performed similarly, except that control is fully automatic and timed to give exactly the desired results. After coating, tubes are dried in a conveyor oven to remove the solvents which are discharged to the atmosphere by means of a hood. The tubes are then fired in a conveyor furnace, at a temperature held closely at 730 deg. F., to oxidize all organic material in the lacquer and leave a coating inside the tube which can be brushed out readily in the case of rejected tubes, but which will adhere firmly in service. Tubes are cooled on the conveyor, and then stacked in carriers, ready for transportation to the final lamp assembly equipment.

Since solvents are used in the ball milling and coating rooms, special precautions are taken here to avoid production of explosive mixtures and to eliminate fire hazards. The new copper-containing, conducting flooring material, Hubbellite, is used in these rooms, which are equipped with vapor-proof lighting fixtures. Wall explosion hatches are provided in the ball milling room. An interesting feature of the tube-cleaning room is a special ventilating system providing quick withdrawal of air from the room at several points to avoid accumulation of dust which may escape from the brushing equipment.

The "sub-assemblies" of coated tubes and finished electrodes are now ready

Simplified floor plan of new windowless, air-conditioned fluorescent lamp plant recently put into operation at Fairmont, W. Va.



for final assembly. The tubes are supported upright in a rotary machine and brought into contact at the lower end with an electrode assembly supported on a small carbon ring. As the machine rotates, at certain positions in its rotation a small induction furnace rises around the tube end assembly, heating the carbon ring by high frequency induction currents and in turn fusing the glass flare of the electrode assembly to the end of the coated tube. The tube is then removed from the machine, annealed and inspected, and an electrode assembly fused to the other end in similar fashion. The second end is annealed and inspected and the tube transported to another rotary machine in which the evacuation and filling are accomplished. Here again the tubes are supported vertically, with the end containing the exhaust tube connected to the evacuating mechanism by a rubber seal. Tubes are carried through a hot zone heated by strip heaters where they are evacuated to about 3 microns by means of oil-sealed, high-vacuum rotary pumps. An automatic mechanism then injects through the exhaust tube one, two or three minute "shots" of mercury, depending on the size of lamp being produced. As rotation continues, the tube is brought beneath a position where a small quantity of argon, sufficient to raise the pressure to about 4 mm., is introduced. The exhaust tube then passes through a gas flame where it is sealed and pinched off.

The lamp is now complete except for attachment of the two molded ends, each of which carries two prongs for electrical connection to the lighting fixture. The prongs are soldered to the two copper lead wires and the molded base is cemented to the tube. After this, lamps are stabilized by lighting for about ten minutes and then every lamp passes to an inspection bench where it is examined for flaws in assembly and tested for lighting characteristics and color. From this point, lamps are transported to the packing department for packing 24 in a carton, ready for a final spot sampling by an independent inspector maintained at the plant by an outside testing agency.

CHEMICALS IN LAMPS

(Continued from page 81)

ous fields within the compound, that when ultraviolet energy is absorbed, this is sufficient for some of the electrons to move to a higher energy level. These electrons do not hold this new position for long, but almost immediately fall back into the original position, liberating the energy in some cases as visible light.

There are some compounds that have this remarkable property as an inherent characteristic of the crystalline substance, as in the case of very pure magnesium tungstate. There are other pure compounds that require an impurity to be added before a high degree of fluorescence can be obtained. Artificial zinc silicate requires about 1 percent of manganese for best results, as is shown in Fig. 1.

Not all impurities will serve as activators, however. This is shown in Fig. 2. As little as one-thousandth of 1 percent of an impurity like iron will make a noticeable decrease in fluorescence of artificial Willemite. Thus it is evident that the purest compounds should be used and only the right amount and kind of impurity added in manufacturing if this is needed. One explanation of the cause of fluorescence in pure compounds when no activator is present is that there are two crystalline forms (as with zinc sulphite) and it is where these two crystalline forms interfere that a strained condition is produced, thus putting some of the electrons in a favorable condition for fluorescence when irradiated with the proper wave lengths of ultraviolet. When impurities serve as activators, little strained islands or centers are formed where the fluorescence is generated, the entire crystal acting as a collector or radiator of energy.

COLOR EFFECTS PRODUCED

Since fluorescence is an internal effect as far as the crystal is concerned, the external form of the crystal does not seem always to be a controlling factor in fluorescence. It is interesting, however, that all of the metallic radicals in the compounds employed inside lamps contain the lower atomic weight metals of the second group of the periodic table. It might also be stated that calcium and magnesium tungstates are blue or blue white; zinc beryllium silicate, white; zinc silicate, green; cadmium borate or silicate, pink; and mercury halides (which are too unstable for lamp use), deep red. This is in order of increasing atomic weight of the positive radical metal as the fluorescent color is shifted from blue to red.

There are only three negative radicals used in lamps at present: boric oxide, silica and tungstic oxide. The structure of the chemical compound alone does not control the color of fluorescent light since in the case of zinc sulphide, several colors may be produced by the kind and quantity of activator.

In producing fluorescence, about the same wave length of ultraviolet energy is absorbed by several of the fluorescent lamp coatings mentioned above. These compounds have been selected for use in lamps because they utilize the energy generated by the mercury discharge in this region. Other compounds may be excited by other wave lengths of ultraviolet or by cathode rays.

Since there are fluorescent compounds having various colors ranging from blue to pink, it is possible to mix the colors so as to get a desired shade and even approximately duplicate natural daylight in this way.

LAMP MARKET

Fluorescent lamps operate at about 40–45 deg. C. This is a relatively low temperature and, since less wattage is required for equal amounts of light, the heating of rooms in the summer time is minimized by their use. Many stores are installing fluorescent lamps for color matching and many offices and factories are being equipped with this type of lighting. It would seem that fluorescent lamps would be desirable in the laboratory where good colors are needed and where the glare of concentrated filament lamps should be avoided, as when titrations are to be made or where detailed visual observation is needed.

In 1941, there will probably be about 20 million fluorescent lamps produced in the United States and in five or ten years, this may be of the order of 100 million. In addition to about 50,000 tons of glass tubing, this latter figure would mean an annual consumption of about 20,000 lb. of highly purified mercury, 700,000 lb. of fluorescent coating material of greatest possible purity and 600,000 liters of high grade argon gas. Also this industry will consume several hundred thousand gallons of nitrocellulose binders and solvents per year.

In mounting the lamps, plastic material will be used for sockets and bases. The transformers and reflectors will require considerable quantities of metals and insulation materials. This does not include the machinery or other materials required for such a production.

Thus this new child of industry not only promises to put further demands upon chemical production, but also may, by better and more efficient illumination, make possible improved manufacturing conditions in the chemical industry.

E.C.P.D. Looks Ahead

ROBERT E. DOHERTY

Chairman, Engineers' Council for Professional Development
President, Carnegie Institute of Technology, Pittsburgh, Pa.

Chem. & Met. INTERPRETATION

In the present period of national emergency, the country is looking more and more to its engineers to assume positions of increased responsibility in our expanding program of industrial production. The Engineers' Council for Professional Development is not, as some believe, merely an accrediting agency for engineering curricula. Rather it is a democratic instrument for enhancing the professional status of the engineer. Presented herewith is an abstract and condensation of a document intended as a report outlining the position in which E. C. P. D. finds itself, as it appears to its chairman.—*Editors.*

The engineering profession faces a great challenge and opportunity. It faces the imperative challenge of the unstable new world it has helped to create, and the opportunity to take a hand in stabilizing that world. But if it plans to meet this clear obligation and assume such a role in the life of the country, it should look ahead, measuring the implied responsibilities alongside its capacities for discharging them. Doing this, it would find one fundamental deficiency to be in the capacity for joint action, and another in the character and extent of the engineer's preparation. It is my conviction that these deficiencies are vital and that concerted thought must be given to their correction; otherwise the profession will probably receive and justly deserve the unhappy distinction of having let its next generation down and failed in its mission.

Most engineers now recognize that their profession does have a heavy responsibility in the accomplishment of national stability, but they evidently do not realize that the profession is not yet fully prepared for that responsibility. I urge that it promptly address itself to the task of becoming better prepared, and I submit that there are definite ways in which E.C.P.D. should contribute to that task. At the same time, I realize that this contribution cannot be effectively made until the constituent groups reach a clearer understanding and persuasion than they now have as to E.C.P.D.'s purposes and potential usefulness.

The constituent bodies have of course demonstrated that they can cooperate. The formation of E.C.P.D. itself is evidence. On the other hand, there is also convincing evidence that professional cooperation has been impracticable. The termination of the American Engineering Council is an instance. The point seems to be that the groups cooperate when it is clear that it is worth while to them individually, and they don't if it isn't.

Today when problems of the engineering profession as a whole are crying for solution, when on all sides of national life extravagant insistence upon self-sufficient independence is creating centrifugal forces that tend to disrupt America, engineers must not, I urge, stand by in an indifferent isolation. They have responsibility; whether they would be or not, they are inevitably involved in both general professional and national interests, as well as in the interests of their own particular group. Clearly they should promote the solidarity of the profession so that it may be in position to deal effectively with its own general problems, but especially so that it may take a more vigorous and constructive interest in the common cause of preserving a democratic future for this country.

Constructive cooperation is at the heart of democratic life. For democracy is not merely an aggregation of groups in several realms such as the political, industrial and professional. Rather it is a system in which these parts are organically related to the whole, and in so far as such a relationship does not exist, the basis for national stability does not exist. And this is the primary reason why the groups of the engineering profession should cultivate the capacity for cooperation.

The second deficiency I have mentioned is in the character and extent of professional training. To promote the professional status of engineers is to promote the effectiveness of the profession. This means better selection of engineering students, more appropriate collegiate training, increased opportunity and incentive for the engineer to continue his education after graduation, and fuller recognition of professional achievement. The full accomplishment of such a program of professional development certainly requires a cooperative effort.

Thus what I am urging is that the constituent organizations of the Council take a greater democratic hand in the affairs of this conference body which, with wisdom and vision, they set up about eight years ago. But I know that before greater professional interest is taken in the present work and the possible further usefulness of the E.C.P.D. in the future, the members of the constituent bodies must understand

much better than they do now just what E.C.P.D. is.

E.C.P.D. is what the charter says it is. This charter is a great document of engineering statesmanship that clearly points the democratic way toward the further development of the solidarity and prestige of the profession. It says, "The E.C.P.D. is a conference of engineering bodies organized to enchance the professional status of the engineer through the cooperative support of those national organizations directly representing the professional, technical, educational, and legislative phases of an engineer's life." To this end it aims to "coordinate and promote efforts and aspirations directed toward higher professional standards of education and practice, greater solidarity of the profession, and greater effectiveness in dealing with technical, social, and economic problems."

An important fact should be emphasized: With the American Engineering Council now defunct, E.C.P.D. is the only body which is in position, by reason of direct representation of professional, technical, educational, and legislative interests of the engineer's life, to deal effectively with the broad problem of professional development. The member groups, however, will bear in mind the fact that E.C.P.D. is an advisory service organization, wholly responsive and responsible to its constituent bodies; and the Council must be cautious to confine itself to matters strictly within the scope of its charter and to avoid the danger of spreading itself too thin. But the fact remains that if cooperative progress is to be made by the engineering organizations, E.C.P.D. is now the only central medium through which that progress can be made.

MEMBERSHIP AND ACTIVITIES

A complete understanding of the Engineers' Council for Professional Development must include a knowledge of its constituency as well as the work in which it is engaged.

The constituent bodies include the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Chemical Engineers, the Society for the Promotion of Engineering Education, the National Council of State Boards of Engineering Examiners, and the Engineering Institute of Canada.

The work of the Council is indicated by the activities of five principal committees. Concerning these activities I append brief reports for which I am indebted to the respective committee chairmen.

1. *Student Selection and Guidance.*—Recognizing the importance of providing for interested young men information concerning the mental, physical, and personal requirements for a reasonable future in the engineering profession, the Committee on Student Selection and Guidance is organizing committees of engineers to meet with those high-school boys who have made inquiries concerning the study of engineering. Gratifying reports have been received concerning the helpfulness to the high-school boy of such personal contact with a practicing engineer.

Linked with the problem of providing adequate guidance to prospective students is that of making possible the selection of better engineering talent. The committee is studying means of measuring more effectively scholastic proficiency and personal fitness for collegiate and professional training.

2. *Engineering Schools.*—This committee, for the first time in the history of our profession, has appraised in an unbiased manner the programs of study of engineering schools, and has prevented a multiplicity of accrediting agencies in the field of engineering education by preparing a list of 542 undergraduate engineering curricula in 125 institutions.

The basis for accrediting has been a sound educational program, and inspecting committees were cautioned against undue standardization or forced regimentation of engineering education. Quantitative criteria were subordinated to qualitative factors as a measure of the soundness of a program of study.

3. *Professional Training.*—Professional training is part of the continuing processes of education that are but barely begun in the engineering schools. In the first few years after graduation, the younger engineer finds his most serious challenge. To aid junior engineers in this critical phase of their development is the function of E.C.P.D.'s Committee on Professional Training. Working with the local sections of the constituent societies, it has encouraged the organization of many junior engineering groups throughout the country. Most of these have for their chief objective improvement in the professional status of their members through study courses, lectures and discussions and plant visits.

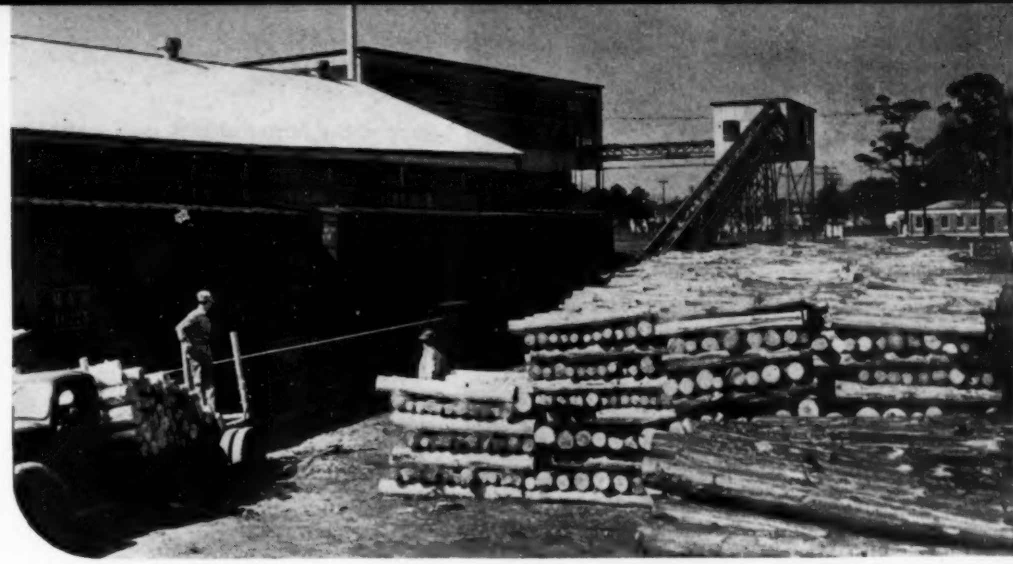
4. *Professional Recognition.*—Professional recognition is a normal goal following the attainment of an engineering diploma and professional training in the school of experience. This committee is concerned with "Methods whereby those engineers who have met suitable standards may receive corresponding professional recognition." The principal agencies according recognition are engineering societies (independent and autonomous, and differing in their requirements for membership) and state engineering registration boards, operating under different laws, in seven-eighths of the states. E.C.P.D. has set up as a "suitable standard" certain minimum qualifications for an engineer—including education and capability developed in practice—which are generally accepted and afford a basis for common requirements for society membership and legal registration.

In its recent annual report the committee urges that our societies make "A study of the Enginering Profession including its present status and development" and seriously consider whether their "profession can adequately meet its obligations and opportunities as an aggregation of individual groups, loosely linked by numerous common agencies."

5. *Principles of Professional Ethics.*—Though progress has been slow, there is now being formulated a preliminary draft of a report on a code of ethics for guidance in the engineering profession. This report will contain (1) a preamble briefly stating the origin and the need in intimate life of canons of ethics, (2) a statement of underlying principles, (3) a statement of reasons for excluding from the present code business rules of practice, and (4) a specific code for ethical conduct.

SUMMARY

The foregoing brief review of the composition, opportunities, and current activities of the E.C.P.D. indicates something of the Council's fitness and of its officers' plans for putting into effect the objectives of its charter, as well as something of the progress which it has already made. Looking ahead, the Council is, I think, justified in the hope that with the active interest and adequate support of the constituent bodies it may serve engineers increasingly in the cause of professional development.



Pine and cottonwood are delivered by barge, truck, and rail. A chain conveyor carries the wood to the second floor of the mill of the National Gypsum Co.

Mobile's Modern Fiberboard Mill

JAMES A. LEE Managing Editor, Chemical & Metallurgical Engineering

Chem. & Met. INTERPRETATION

Here is a new process industry plant which was designed so as to take advantage of the very last word in materials handling and processing equipment. It is interesting from the specially designed device used for unloading logs and the modern system for conveying them to the processing buildings to the infra red drying of the coating material on the finished products.—*Editors.*

Mobile is the site of the new fiber wallboard mill of the National Gypsum Co. Here Southern pine and cottonwood are converted into insulation, acoustical and decorative boards rounding out the company's line of building materials.

The mill is located on a 65-acre track along the Bay. Mobile is especially attractive for such a plant from the standpoint of supply of raw material, low manufacturing costs and low price of power and natural gas for fuel and energy. It was considered to be one of the most strategic locations to serve the trade. The especially well developed transportation facilities make it possible to ship at low cost to the Eastern Seaboard and to South American countries. The mill also benefits from favorable rail rates to inland markets. Sidings from the Gulf, Mobile and Northern Railroad serve the plant. Facilities were also provided to ship by truck.

These transportation facilities simplify the problem of getting the wood supply from the forests to the mill.

This modern wallboard mill was designed and constructed by H. F. Ferguson Co. with the cooperation of National Gypsum's engineers. Provision was made for future expansion of this $2,000,000 plant. The buildings are steel frame construction and the side walls of Transite. The floors are concrete, and the monitor type roofs are covered with insulation board to improve working conditions during the long summer months. Seventy percent of the wall space is occupied by windows, providing excellent daylight. Washrooms and locker facilities are the most modern obtainable.

The accompanying pictures of the mill are from a feature of the August issue of *Electrified Industry.*

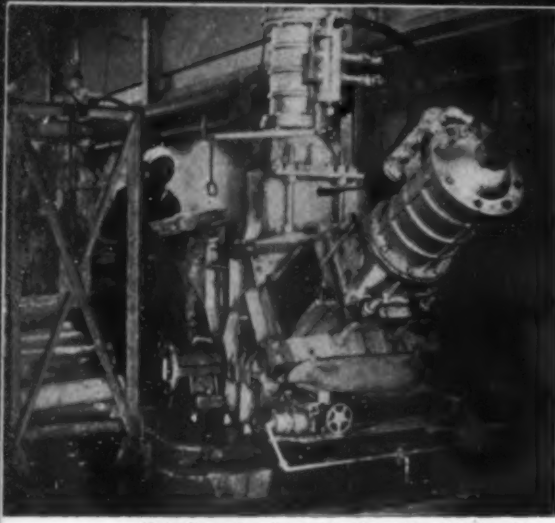
Besides the main process, fabricating and storage buildings there is an office building which is completely air conditioned, also control laboratory, machine shop, boiler house and switchboard-room.

In designing the layout of the plant provision was made for straight line flow of materials. From the moment the wood, the principal raw material, arrives there is a continuous straight movement to the shipping of the finished product.

Both pine and cottonwood are used, although they are processed separately. The former is used for making high-density products, building board, sheathing, tile, lathe, roofing insulation and specialties. The cottonwood which is longer fibered is used for making acoustical board.

Logs are brought to the mill in barges, trucks and by railroad. (The company operates its own barges). A specially designed device unloads the logs from barges. The wood supply is rotated in the yard so as to assure uniform aging. A modern system for conveying wood from the yard was installed. This 1,200-ft. chain conveyor travelling at the rate of 100 ft. per min. carries the logs to the second floor of the mill where they are discharged into the slasher. Saws cut the logs into 2-ft. lengths. The wood then drops into a barking drum where it is cleaned. The cleaned logs are brought to the grinders on trucks.

Grinding is done in five three-pocket hydraulic machines equipped with manufactured stones. The ground stock is discharged into a channel below and through a primary (large revolving) screen, which re-



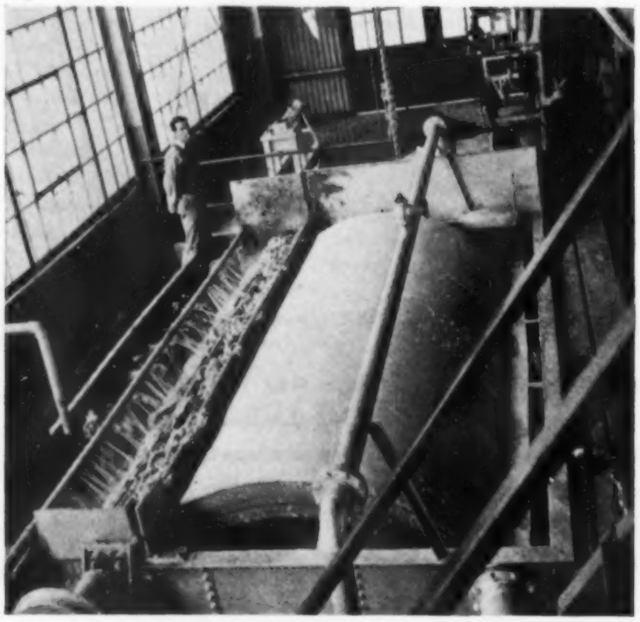
Grinding is done in 3-pocket hydraulic machines with manufactured stones

moves the larger slivers in the stock. Rejects are passed through a refining process where they are reduced in size by attrition mills and returned to the stock channel.

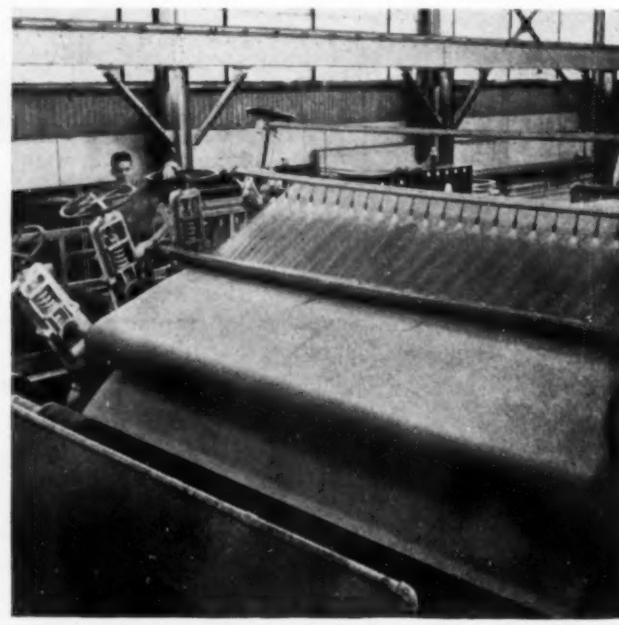
The stock is pumped up to the secondary screens (Trimbey centrifugal screens) on the second floor. It is thickened on deckers to about 5 percent solids and stored in thick stock chests. Regulators then lower the consistency to 4½ percent. On leaving the regulator the stock goes first into storage chests and next into the machine chest. It is then pumped to the stuff box, the head box and later to the cylinder vat in turn.

A single cylinder machine converts the stock into board which comes out onto a saw table where it is cut into sheets 12 ft. wide and from 8 to 20 ft. in length. A tipple loads them into an eight-deck tunnel dryer. It is 300 ft. long and heated by direct gas burners utilizing approximately 1,000,000 cu. ft. of gas a day. The interior is protected against possible fires.

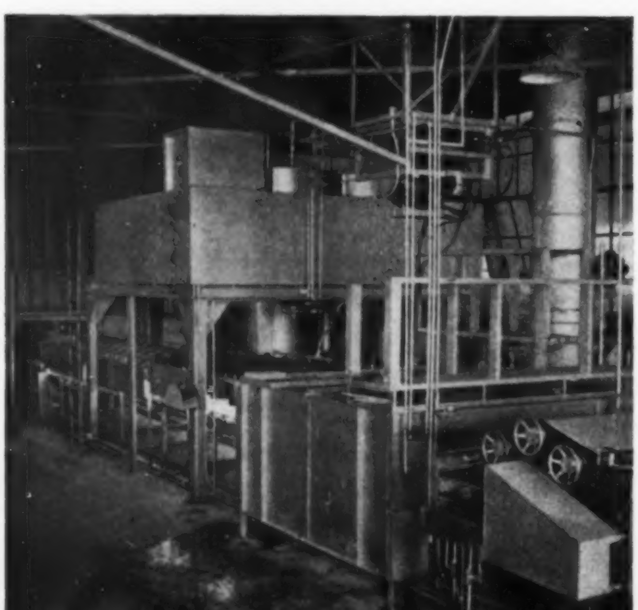
As the sheets leave the dryer they pass to a two-direction trimmer which reduces the large loads into several smaller ones. They next go to the



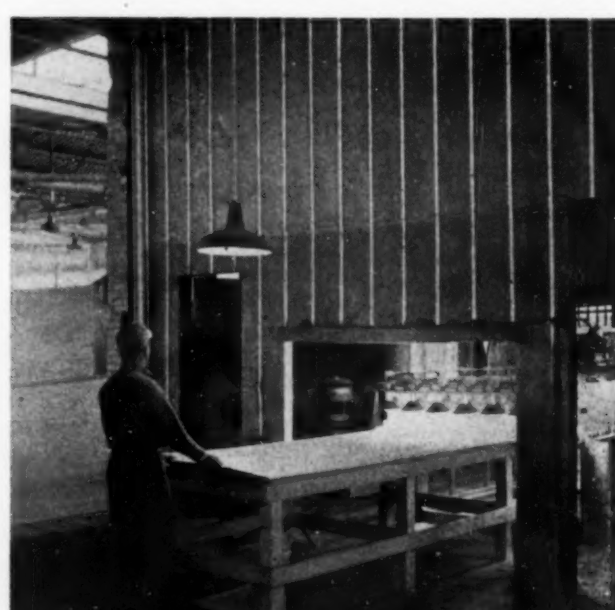
The stock is thickened on deckers to about 5 percent solids and stored in stock chests



A single cylinder machine converts the stock into boards 12 ft. in width. These are dried in a 300 ft. tunnel dryer



A washable finish is applied to one of the products in a spray machine. Aniline dyes are used in colored products



The finish applied by spraying is dried as the board passes beneath infra red lamps of 250 and 500 watts

fabricating department where they are made into tile, roofing insulation, lathe and other products. A washable finish is applied to one of the products in a spraying machine. The coating is dried as the board passes beneath a large number of infra-red lamps. Lamps of 250 and 500 watts are used in combination.

In the case of another product, a coating of asphalt is applied and then covered with aluminum paint. These boards are dried by circulating air over the surface. All products are carefully inspected before being wrapped in heavy paper, stenciled and shipped.

The fiber board is waterproofed to 18 percent by weight to insure sufficient bond between fibers and to prevent deterioration due to changes in atmospheric conditions. The sizing agent is a wood rosin emulsion. The 70 percent emulsion is received at the plant in tank cars and is reduced to 30 percent before using.

Since the emulsion is alkaline the stock is treated with soda ash to put it on the alkaline side. The emulsion is added to wet stock at the decker conveyor and dispersed through the fiber by pumping and agitation in storage chests. The stock is then returned to the acid side by the addition of alum. This breaks the emulsion, the rosin being coated on the fibers as aluminum resinate. Very close control is kept by measuring the pH before the emulsion is added and after the alum is added.

Colored products are produced by the addition of aniline dyes while the stock is in the storage chest. By incorporating the dyes early in the process they thoroughly penetrate the fibers. Four colors are produced: grey, cream, tan and buff.

Freeness tests are made hourly on each grinder and also on composite stock at the decker. Wet mat is tested hourly to determine density and thickness. Finished board also is tested hourly for density, thickness, moisture content and absorption, tensile strength and modulus of rupture.

The water supply comes from three deep wells of 700 gal. per min. each. This water is added at several points in the process. It is added as make-up water to the recirculated water in the plant. The white water from the decker is recirculated in a system in which the stock is to be kept alkaline. While the water from the forming machine, which is acid, is recirculated where the stock is to be kept on the acid side.

All power is purchased from the Alabama Power Co. Total connected horsepower is 5,500. There is 3,500 hp. in synchronous motors. The balance is in induction motors. The main machine drive is a synchronized back line drive. Steam used for emulsifying and for refining operations is generated in 100 hp. gas-fired boiler. It is controlled automatically and therefore requires little attention.

Largest Shell-Loading Plant Goes Into Operation

The Iowa Ordnance Plant at Burlington, Iowa is one of the largest shell-loading plants in the world. It will be operated by Day & Zimmermann, Inc., of Philadelphia, will cost $30,000,000 and will require 7,000 employees.

The plant will load artillery shells, bombs, and the corresponding components. Each loading line will be in operation as soon as it is completed. A separate loading line was scheduled for completion August 1, while the bomb-loading line and the detonator line are scheduled for completion soon thereafter.

The loading buildings are divided into many small rooms separated by protective walls of reinforced concrete. The roofs and outer walls are of light, corrugated asbestos which would reduce the force of explosions.

All electric light fixtures in the plant are of special design for rapid diffusion of heat. Floors of all rooms where men work with explosives are of specially finished, smooth, waxed concrete that cannot collect dust particles.

Empty shells are received in a building as clean and bright as a new dairy. So much of the loading process is automatic that, from the time the shells arrive until they are taken from the end of the line, they are seldom touched by a human hand. Shell loading is done on a production line roughly similar to an automobile assembly line.

Revolving machines carry the empty shells through paint spray booths. After painting, the shells are caught up by overhead tongs which place them in jiggle-proof "tote boxes", like wooden egg boxes, and a conveyor carries them to the melt-loading building.

The conveyors, which were specially designed for this type of plant, link together the various process buildings of the loading line. These buildings are located far apart for safety, and extend for more than a mile. They have two "tracks" of rollers over which the tote boxes are moved by "pusher" arms extending from a moving chain as a sort of "third rail." The conveyors are explosion-proof and are housed in corrugated asbestos siding and roofing.

A conveyor also carries TNT, packed in wooden boxes, to the melt-loading building from another part of the plant. The TNT is melted on fireless stoves, heated by steam, in rooms on the second story, and the liquid is piped downstairs into ladles from which it is poured by hand into the shells.

The shells are conveyed to another building where they are cooled and filling completed. Then they are taken to a drilling building where a bore through the solidified TNT is made in the nose of the shell for the booster and fuse. The motors which turn the drills are powered by compressed air and have sparkless bearings.

After being drilled, the shells are placed in storage magazines at the plant, ready for trans-shipment to various ordnance depots.

The plant consists of more than 500 buildings located on a site covering 20,000 acres, and has 75 miles of railroad tracks and 75 miles of electric lines. Its power plant can furnish electricity sufficient to meet the needs of a city larger than Burlington, Iowa. The plant has its own water supply.

The entire area is surrounded by 25 miles of wire fence seven feet in height, while inner areas are similarly fenced. The whole is illuminated at night by flood lights.

Materials used for construction include 13,000,000 board feet of lumber, 3,600 tons of reinforcing steel, 181,000 railroad ties and 65,000 cu. yd. of cement. There are more than 100 miles of roads, 40 miles of water piping, seven miles of steam heat lines and 15 miles of sewage pipe lines.

Experimentation and research work conducted by the Ordnance Department of the army at Picatinny Arsenal, Dover, N. J., for many years, as well as close collaboration between the army and its contractors, have gone into the design.

Progress Report on Liquefying City Natural Gas Supply

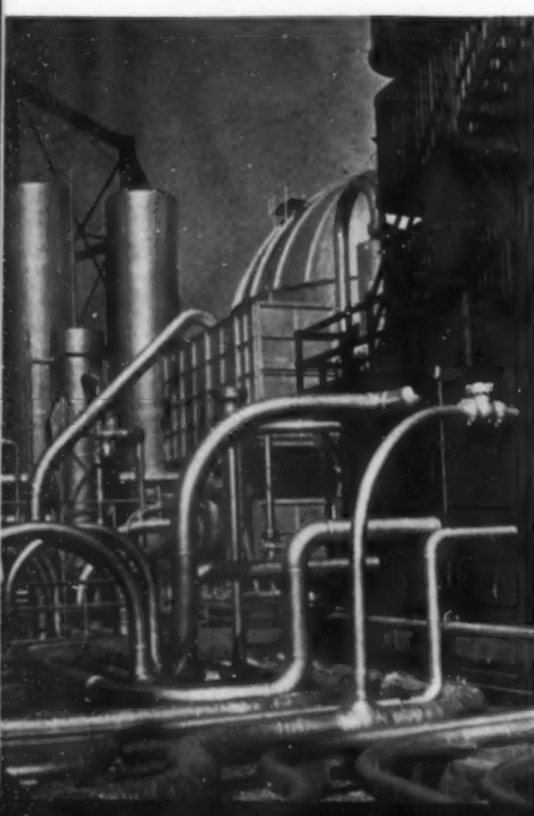
JOHN A. CLARK
Chief Engineer, Hope Natural Gas Co., Clarksburg, W. Va.

Chem. & Met. INTERPRETATION

This article, an abstract from the June 1941 issue of the *American Gas Association Monthly,* is based on a paper presented by the author in May at the A.G.A. Natural Gas Convention at Dallas, Tex. An interesting method of solving the peak load problem, this process of storing natural gas in the liquefied form was described in considerable detail on page 74 of our January 1941 issue.—*Editors.*

LAST YEAR at the Atlantic City meeting of the American Gas Association, it was my privilege to read a paper describing the development of a new type of storage plant being constructed by The East Ohio Gas Co., in Cleveland, Ohio. This paper is a progress report describing the results obtained by the first winter's operation of this plant, and giving some of the conclusions reached after this operation. (See review in *Chem. & Met.,* January 1941, p. 74.)

The plant was designed with a capacity to turn into a liquid 4,000,000 cu. ft. of natural gas per day. It was practically completed, in all essentials, on January 29, 1941. Operation was started at once, and on February 7, the first production of liquid gas was started.



Part of the Cleveland plant for storing liquefied gas (photo by A. I. Phillips, courtesy A. G. A. *Monthly*)

COLD WEATHER PERFORMANCE

The first cold wave hit on February 19, and at that time 15,000,000 cu. ft. of liquid gas was in storage. On February 19 a total of 7,000,000 cu. ft. was regasified and put back into the lines and about 4,000,000 cu. ft. on February 20. On February 21 the weather moderated and it was possible to go back to liquefying again. On March 17, when the most severe cold wave of the winter hit Cleveland, 50,000,000 cu. ft. was in storage. During the two days of this cold spell, the plant fully justified its construction, as 16,000,000 cu. ft. was regasified and put back into the city plant on March 17; and 5 000,000 cu. ft. on March 18. Owing to inability to foresee what was ahead in the way of weather, and the desire to conserve all liquid possible, only the minimum amount necessary to keep operating conditions normal was used.

The result to the gas company of this plant was the ability to handle without curtailment an industrial load of over 40,000,000 cu. ft. per day, which most certainly would have been curtailed or shut off for at least two days, with the resultant loss of confidence on the part of industrial users.

In regard to the cost of the plant, the figures are not very complete at the present time, because the work was not entirely completed last winter and several construction accounts are not closed at this time. However, the final cost will run around $1,250,000 divided roughly into: Engines with foundations and buildings, $260,000; the three spheres and piping, $420,000; and the remainder in piping, cooling tower, heat exchangers and auxiliary equipment. Also included was an already installed boiler plant which was reconditioned and put in service.

OPERATING COSTS

Because of the short time the plant was actually liquefying and the fact that construction work was going on simultaneously, there are no reliable figures on operating costs, but the experience obtained allows a very good estimate of the probable cost of liquefaction and regasification. The plant was designed for and will make, after some tuning up, 4,000,000 cu.ft. per day of the liquid. To fill a storage of 150,000,000 cu.ft. requires a run of 38 days or, allowing for starting and having to cool the piping and tanks and allowing for a few days' delay, about 50 days. To operate the equipment requires four men on a shift. Figuring the fuel gas at an average cost of 38 cents per M cu.ft., the cost of filling the three tanks will be: labor, $6,000; fuel gas, $13,700; oil, ethylene and supplies, $4,000—a total of $23,700. The $23,700 divided by 150,000,000 cu.ft. equals 15.8 cents per M cu.ft.

Now, assuming that the plant is started up in October and the storage is full by December 1, to keep the plant warm for four months will require 38,000 gal. of fuel oil for making steam, while to regasify the 150,000,000 cu.ft. of liquid will require 462,000 gal. of fuel oil or a total of 500,000 gal., equal at 4 cents per gallon, to $20,000. The labor cost of keeping a crew available during the four months will be $12,000, or a total of $32,000. This, divided by 150,000,000 cu.ft., gives 21.3 cents per M cu.ft. for regasification, making a total for liquefaction and regasification of 37.1 cents per M cu.ft.

However, we had expected, since a cold wave is seldom of over three or four days' duration and is then followed by about a week of warmer weather, that it would be possible

(Please turn to page 92)

Timesaving Ideas for Engineers

NEW NOMOGRAPH SOLVES FLOW EQUATIONS FOR THIN PLATE ORIFICES

CLARENCE J. SCHILLING *Engineer, Cleveland Wire Works, Euclid, Ohio*

For everyday application to problems in flow measurement, no device is more useful than the thin plate orifice. Only one dimension must be known accurately, the orifice diameter. Given a pipe through which is flowing the fluid whose rate of flow is to be measured, it usually means only the insertion of a pipe union, between whose flanges the orifice is inserted; and an upstream and a downstream nipple to which the manometer is attached.

As ordinarily derived, the flow formula is

$$V = Cf\ (\pi/4)\ D_2^2\sqrt{2gH}$$

where V = flow in cubic feet per second; H = differential head of flowing fluid in feet; D_1 = pipe diameter in feet; D_2 = orifice diameter in feet; C = coefficient of discharge; and f = the velocity of approach factor

$$1/\sqrt{1-(D_2/D_1)^4}.$$

If we combine the discharge coefficient with the velocity of approach factor, letting their product be C_f, then

$$V = C_f\ (\pi/4)\ D_2^2\ \sqrt{2gH}$$

In shop practice we are usually interested in quantity per hour. Orifice diameters are given in decimals of an inch, and the available pressure is approximately just that required for use, so that it is advantageous to employ small loss of pressure. For these small pressure differences a water manometer is best adopted. To change to these units, let Q = cubic feet per hour of fluid flowing = 3,600 V, and $H = \Delta P/\gamma$, where ΔP = differential pressure in pounds per sq.ft. and γ = fluid density in pounds per cu.ft. Also let R = inches of water equivalent to ΔP = 407 $\Delta P/(14.7 \times 144)$, because atmospheric pressure equals 407 in. H_2O and there are 144 sq. in. in 1 sq. ft.; and d = orifice diameter in inches = 12 D_2. Then

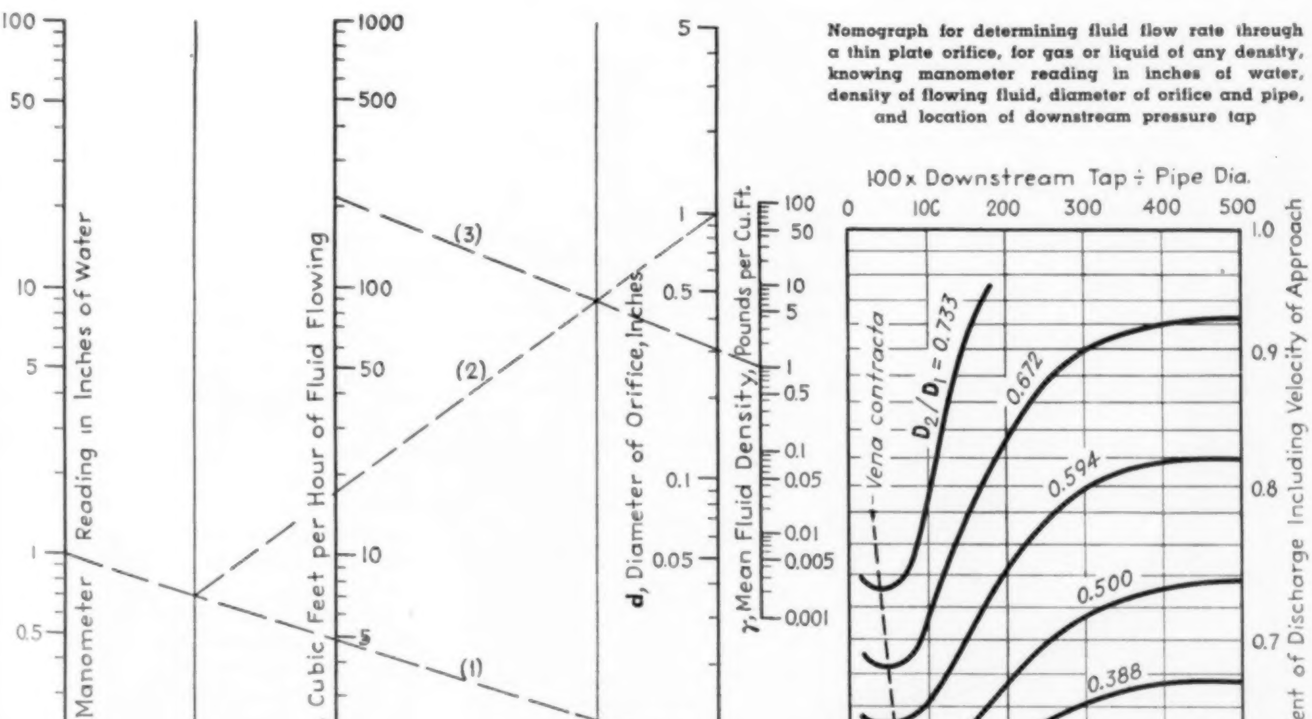
$$Q = 3{,}600\ C_f\ \ (\pi/4)\ \ (d^2/144) \times \sqrt{64.4\ (14.7 \times 144R)/407\gamma}$$

or

$$Q = 359\ C_f\ d^2\ \sqrt{R/\gamma}$$

When gas flow is measured, and R values are large, an additional coefficient or compressibility factor is usually provided in the flow equation. This may be avoided, however, if it is remembered that γ changes with pressure and temperature, and if we take the density corresponding to the mean condition.* Thus, neglecting temperature change, take the density corresponding to $(P_1 + P_2)/2$ where P_1 = upstream and P_2 = downstream pressure. The flow then represents Q cu. ft. per hour of fluid at this same density. If equivalent standard conditions are wanted, the equation must

* U. S. Bureau of Stds., Research Paper No. 49.



Nomograph for determining fluid flow rate through a thin plate orifice, for gas or liquid of any density, knowing manometer reading in inches of water, density of flowing fluid, diameter of orifice and pipe, and location of downstream pressure tap

be corrected to standard temperature (T_s) and pressure (P_s), thus:

$$Q_s = Q \ (P_1 + P_2) \ (1/2 P_s) \ (T_s/T) = Q\gamma/\gamma_s$$

If weight rate of flow is wanted it may be obtained directly by multiplying both sides of the next to the last equation by the density γ:

$$W = Q\gamma = 359\, C_f\, d^2 \sqrt{R\gamma}$$

Similarly, standard gas volume may be directly translated into weight units or $W = Q_s\gamma_s$.

So, either the last two equations may be used for a gas, or the preceding pair.

Next must be considered the value of the coefficient C_f, and since this now includes the velocity of approach, it varies with the ratio of orifice to pipe diameter and also with the position of pressure taps, especially the downstream pressure tap. Assuming an upstream tap one-half pipe diameter or more from the orifice, the coefficient C_f may be obtained from the accompanying graph based on a similar graph in an A.S.M.E., research publication on Fluid Meters. The graph has been plotted so that the vertical scale is logarithmic and thus can become a part of the nomograph on which it appears.

To find the flow (liquid or gaseous) through an orifice in a given pipe find: (1) The ratio of orifice to pipe diameter; (2) location of the downstream tap as percent of pipe diameter; and (3) the corresponding coefficient of discharge C_f. With this last value as a pivot from the scale at left edge of the graph, proceed by the straight lines, (1), (2) and (3) as illustrated in the example given on the nomograph. The case shown would correspond to a flow of 219 cu. ft. per hour through a 1-in. orifice in a 4½-in. pipe, the downstream pressure tap being 6 in. from the orifice and the mean fluid density 1 lb. per cubic foot. As indicated, the coefficient of discharge for this case is $C_f = 0.61$, and the pressure differential to which it is connected by a straight line is R = 1 in. H_2O.

Filter Wash Control

A SIMPLE METHOD for controlling the washing of chemicals on filter presses has been worked out by the Crown Chemical Co., Ridgefield, N. J. This company is producing zinc stearate, which must be washed free of zinc sulphate; and iron phosphate, from which NaCl must be washed to an end point of not over 1 grain per gal. NaCl above the original wash water. Formerly the wash water was sent to the laboratory for check-up during washing. Now a simple electronic solubility indicator (made by Industrial Instruments Co., Jersey City, N. J.) is used, first to check the incoming wash water, then to determine the concentration in the water leaving the press.

Positive Cut-Off Bin Gate

CHESMAN A. LEE *Engineer*
Darling & Co., Chicago, Ill.

FORMERLY in the employ of a large material-handling engineering company, the writer has worked out several ideas which, although successful, have never appeared either in catalog or article. The bin gate described below should be of interest.

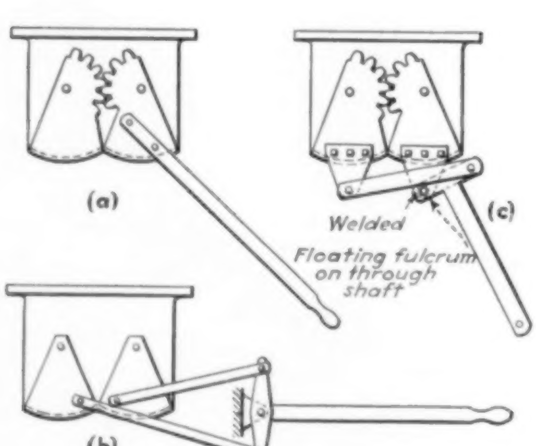
The customer had a mixture of lumps and fines to feed into a larry car from an overhead bin and demanded a clean cut-off at exact weight. It was necessary for the gate to cut lumps and to be tight-sealing.

The gate we had originally furnished was of standard "duplex" design, as in sketch (*a*), and did not have enough leverage. Leverage was applied to one leaf directly, and to other leaf through gear quadrants. Frictional loss is proportional to the required closing force and was excessive for proper cutting.

For severe duty gates are often furnished with each leaf receiving independently its pull and push from opposed levers mounted on a shaft, as in sketch (*b*). This works very well but requires a support for the shaft. Incidentally, the gate leaves must be plain, that is, without gear quadrants.

A convenient support as required for the above design was lacking, but we were able to use a floating mounting with opposed pull on the gate leaves, which permitted retention of the gear quadrants, as in sketch (*c*).

Here the shaft was mounted on one gate leaf and yoked directly to the other leaf in such a way that the gear quadrants served merely to center the leaves. Friction was minimized, the action was really positive and the gate was completely successful.



Three bin gates described in text: (a) Gate which did not permit proper cutting action; (b) gate requiring support for lever; (c) successful design giving positive cut-off action

LIQUEFYING NATURAL GAS
(Continued from page 90)

after a cold spell to refill the tank and to use 300,000,000 cu.ft. of liquid during a season. To do this will require an operating cost for labor, oil, fuel gas, etc., of $73,400, or dividing by 300,000,000 cu.ft., a cost of 24.4 cents per M cu.ft. Until the plant has made a full season's run, it will be impossible to say exactly which condition will be the actual one, so, for the present, it seems safe to say that the operating cost will be somewhere between these two figures. In addition to the operating costs, of course, there will have to be added the fixed charges on the first cost of this plant.

One other feature of the plant which was very much discussed during the design was the rate at which heat from the atmosphere would filter into the inner tank through 3 ft. of cork insulation to the liquid, at a temperature of around 260 deg. F. below zero, and what the evaporation would be per day while the tanks were standing full of liquid, waiting to be used. From the experimental work and the pilot plant, it had been figured out that there would be a heat transfer of about 0.25 B.t.u per cubic foot. Using these data we figured that about 500,000 cu.ft. would evaporate per day. At the present time, one tank has stood nearly full of liquid for about three weeks, with all the evaporation from it and the connecting piping going through a calibrated meter. During this time, which included several fairly warm days, the evaporation varied from 105 to 115 M cu.ft. per day. Therefore, it seems quite safe to say that the evaporation with all three tanks full will be around 350,000 cu.ft. per day. This would mean that, with all three tanks full, not much over one-half of the liquid would evaporate in the course of a year.

In conclusion, I think I can say that the management feels that this plant has operated successfully for its first year and has fully justified the money invested in it. However, it must be realized that it is not a "cure-all" and must be carefully engineered to suit each individual case.

CHEM & MET REPORT ON

Process Steam and Power for Process Industries

TO PROCESS INDUSTRIES EXECUTIVES AND ENGINEERS

No industries are more concerned with the availability of a plentiful supply of steam for process heating, and low-cost electrical energy, than is the process industries group. On this account Chem. & Met. has several times in the past thought it worth while to devote rather extensive editorial features to this subject. The report which follows is an attempt to bring these earlier discussions up to date in as simple and brief fashion as possible. To this end the report describes the more important advances in steam and power generation, discusses pros and cons of byproduct power production, considers the factors making for high efficiency in these critical times. For those engineers who feel the need of a review of the theory, a short section sketches this subject without mathematics, using a graphical presentation.

CHEMICAL AND METALLURGICAL ENGINEERING

AUGUST, 1941

Developments in Process Steam and Power

SUMMARY AND CONCLUSIONS

Chemical process industries are tremendous users of process steam and power. In 1939 they consumed about 40 percent of all fuel used by manufacturing industries, bought a third of the power used by all manufacturers, and generated about an equal quantity of electricity. Although steam for heat and power are such important matters to chemical engineers, however, they cannot be expected to be specialists in that field, which is why *Chem. & Met.* feels the need for an occasional review, written from the chemical engineering viewpoint. This report, therefore, has a two-fold purpose: to discuss trends in industrial power generation, and to review some of the theory involved. Particular emphasis is paid to the combined production of process steam and byproduct power, which gives process industries an advantageous position when it comes to electrical generation. However, as the report shows, decision whether to generate or purchase can only be made after careful study.

Chemical engineers, in their design and operation of the plants of the process industries, are dependent to a large extent on the availability of dependable and low-cost process steam and power. In several types of chemical engineering plants, for example, aluminum, electrolytic caustic soda, and pulp and paper, this dependence is greater than in almost any non-process industry. Therefore, *Chem. & Met.* again takes up a subject to which whole issues were devoted in September 1927 and April 1932, as well as many individual articles in intervening years. This is not to advocate that chemical engineers should become specialists in power services, although that is occasionally necessary. Rather, we again review some of the fundamentals and some of the advances in this field in the belief that at least a bowing acquaintance with the problems of steam and power generation is essential to chemical engineers if they are to know what can be done; if they are to utilize these services as efficiently as possible in designing their processes; and if they are to work most effectively with the specialists in design and operation of power facilities.

Process industries rank extremely high among manufacturing industries as consumers of energy, both as fuel and as purchased power. Energy supply for the process group was discussed at length in an eight-page report in our March 1941 issue. However, by way of summary and to present a number of more recently available figures from the 1939 Census of Manufactures, it is worth noting here that industries in this field consumed 72 percent of the bituminous coal used in all manufacturing industries; nearly 52 percent of the fuel oil; about 39 percent of the natural and manufactured gas; nearly 44 percent of the anthracite coal; and not quite 2 percent of the coke; a total of about 40 percent of all industrial fuel.

On top of this, 33 percent of all electricity purchased from utilities by manufacturing industries was consumed in process plants which, in addition, generated in their own equipment more than half of all electricity produced by manufacturing concerns, and about half their own requirements. In 1939 process industries consumed in generated and purchased power over 30 billion kw.-hr. compared with about 77 billion for all manufacturing establishments. They possess 32 percent of all manufacturing generating capacity and 27 percent of all motor horsepower.

The outstanding characteristic of the energy load in most process industries is the co-existence of demands for both process steam and power. Of course, the demand for one may overbalance the other badly, as in the cement industry where direct heat and electricity are needed; or in alumina reduction, where the load is mostly electrical. On the other hand, in many industries, as in pulp and paper manufacture, an approximation of balance between heating steam and electricity requirements is entirely possible, in which case the minimum overall cost for energy can be realized.

It is an old story that process steam load makes for economical power generation, but it should be retold here as introductory to a consideration of the problem of whether to buy or generate a plant's electrical requirements. Power can be made with a condensing prime mover, in which case it must bear the total steam cost; or it can be skimmed from process steam by passing the latter through a non-condensing prime mover, exhausting to the process. Even the mercury-steam binary cycle as operated at Schenectady, Hartford and Kearny, cannot produce 1 kw.-hr. for less than 9,200 B.t.u., while central station steam plant practice rather rarely improves on 12,000 B.t.u. in fuel to produce a kilowatt-hour of electricity. But with power produced as a byproduct of process steam generation, even the poorest prime mover will rarely extract more than 4,000 B.t.u. from the steam passing through, in generating a unit of electricity, leaving the remaining energy in the steam for use in process.

Looked at from another viewpoint, even the best steam station

of the condensing type wastes 10–15 percent of the heat value of the fuel in boiler and stack losses, and another 50–55 percent in heating the condenser water, which is of no value to anybody. Even an ordinary byproduct power generating plant, on the other hand, can hardly waste more than 30–35 percent in the boiler and stack, while most of the remaining heat, close to 70 percent on the average, is available for useful purposes in byproduct electricity and process heating.

BUY OR GENERATE?

The case for generation of byproduct power in industries having a process steam load would thus appear to be a cut-and-dried proposition. Actually, nothing so simple as this is true in power generation. Power problems cannot be solved by rule, but only by a careful analysis, made by a competent engineer, of every factor entering into each individual problem. Even similar plants in the same industry often require quite different set-ups, owing to slight variations in the surrounding conditions. When it is appreciated what a broad range of power needs is encompassed in process industries, then it will be clear that the best solutions cover the entire front from steam generation alone, with 100 percent power purchased, to electrical generation with condensing turbines alone.

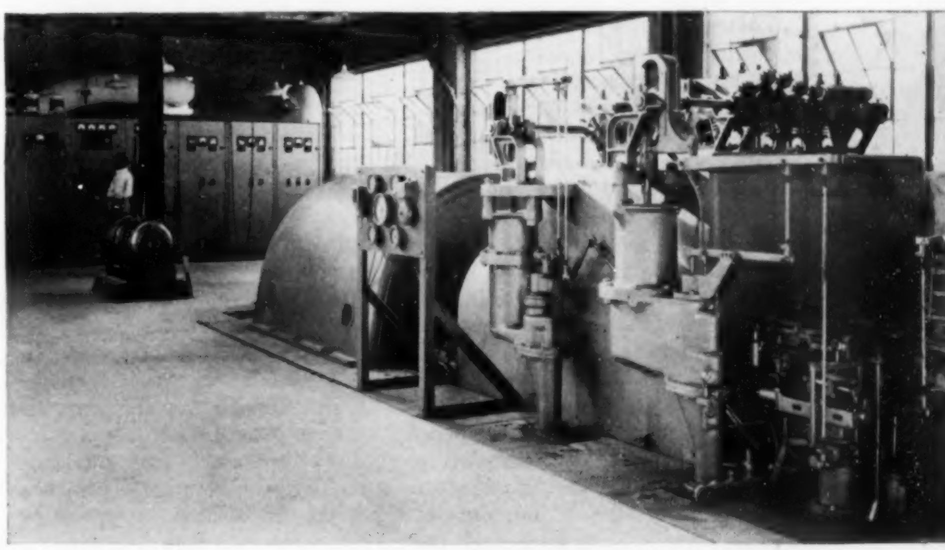
Process industries thus encounter all gradations in power requirements from a process steam load alone, to an energy requirement completely in the form of electricity. At either extreme, the choice between purchase and generation can usually be made in fairly simply fashion. However, most plants lie somewhere in the zone between these limiting end points. Power requirement may be minor, and steam the overbalancing factor, in which case the solution of steam production plus byproduct power generation is usually not far to seek. A second variation of this intermediate position is the fortunate plant where power demand substantially equals what can be produced by passing the total process steam supply through a non-condensing prime mover. Finally, in the least favorable position from the standpoint of home-made power is the plant with relatively small process steam needs and an overbalancing power requirement. Here the problem of generating in condensing equipment comes to the fore, the solution to which necessitates a decision as to whether the plant should simply produce what steam it needs, or attempt to compete in its own bailiwick with the utility whose lines are most readily available.

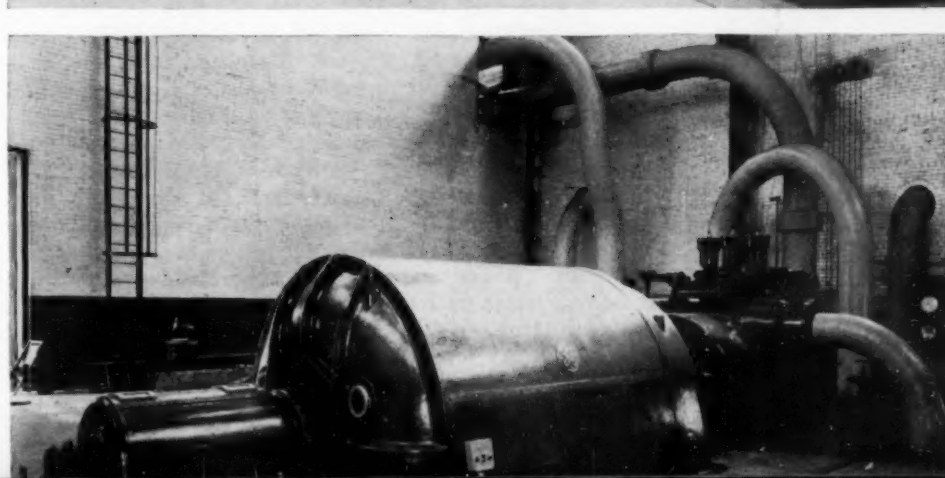
In the foregoing we have spoken of a plant's steam and power requirements as if they were fixed things—constant in absolute quantity and fixed in relation to each other. Actually, such an ideal situation is quite rare. If it were otherwise, the solution in an individual case would be much simplified. Instead, it is not at all unusual to have power and steam requirements substantially in balance during one period of the working day, out of balance in the direction of steam at another time, and of power at still a third period. Often this situation can be materially improved by proper scheduling of the use of heavy consumers of steam and power. Such scheduling will always pay a handsome dividend.

What are some of the factors in deciding whether to purchase or generate? An important one today, of course, is the fact that power equipment is becoming ever more difficult to secure, and deliveries are being pushed farther into the future. On the other hand, power companies in some areas are becoming less and less anxious to take on large new blocks of power, so that in some instances an attempt to establish generating facilities may be forced on the plant.

Power generation is one of the oldest and best established of all unit operations. A tremendous amount of development work has been done, particularly in central station work, and it cannot be taken for granted that even a large power user can generate his own requirements as cheaply as they can be secured from a utility. Another factor to be considered is that new processes, until they have been proved, had best be supplied with purchased power to avoid the chance of increasing a bad investment. Also there is often the possibility of buying "off-peak" or "standby" power at extremely low rates. Where an industry employs batch processes which can be shut down during relatively short periods of the day when off-peak power is not available, this

Typical industrial turbine rooms: Above, non-condensing double-extraction turbine in Hollingsworth & Whitney paper mill, Mobile; below, non-condensing superposed turbine used by Weirton Steel; Both are General Electric installations





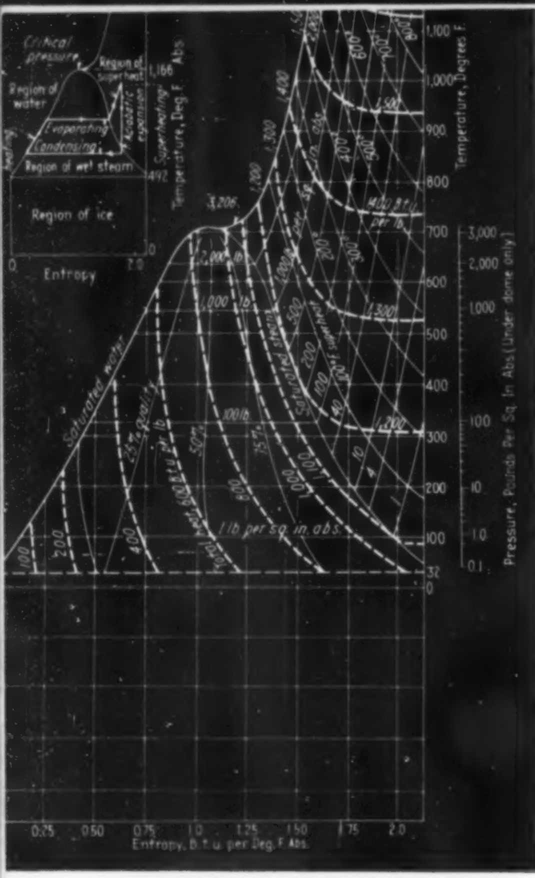


Fig. 3—Skeleton temperature-entropy diagram, a type useful in visualizing power and process steam problems

method is often attractive. Standby power, which is likely to be available all but a few days of the year, except when some emergency forces the utility to employ the standby load for other purposes, is suitable for industries having large and steady loads which can safely be dropped, occasionally and without warning.

Against such possibilities of saving, the process industry having a process steam load large enough to generate all or a considerable part of its power requirements may be able to show a power cost considerably below that of the utility. Whether to go to the highest pressures for which equipment is available is a moot question, since there are many problems with plants operating over 600 lb. and 750 deg. total temperature which are not encountered in lower pressure and temperature plants. From the standpoint of thermal efficiency, the advantage lies definitely in the higher pressure range, but the disadvantages must be weighed before arriving at a decision to go the whole way.

One factor that must sometimes be taken into account, depending on the sort of process load, is the reliability of the utility power obtainable. With the development of power networks, utility power in many areas has become much more reliable, with unlikelihood of serious interruption due to storms and accidents to the transmission line. The plant which is remote from industrial areas, and hence is probably served by only one line, may well have to consider the consequences of a power interruption of substantial duration. With others, however, the problem would now appear to be of minor consequence. Before a plant decides to generate part of its power as a byproduct of process steam and purchase the rest, it is important to compare the cost of this extra power, as produced in the plant by means of condensing equipment, with equivalent power purchased from the local utility. If this additional block of energy is relatively small, and particularly if it is variable, rates quoted by the utility may well show the desirability of the plant's installing the additional condensing equipment. On the other hand, a relatively large and steady block of power will probably show an advantage for the utility rate.

BRIEF THEORY

Most chemical engineers have little occasion to use the steam tables for power (as distinguished from heat) problems, so that a brief review of fundamentals, *sans* mathematics, may not be out of order. Steam tables give the following properties for 1 lb. of water or steam at various temperatures and pressures: (1) Saturation temperature, and total temperature in the case of superheated steam; (2) pressure; (3) volume; (4) total heat above 32 deg. F.; (5) entropy; (6) internal energy. Tables do not permit the visualization of thermal processes, so that charts are often used. The Mollier diagram plotted on the total heat-entropy plane is best for most practical use, but is not a good visualizing chart. To permit "seeing" the energy changes taking place in any thermal process, and particularly the "unavailable" energy, a plot of the properties of 1 lb. of steam or water on the temperature-entropy plane (T-S plane) is most suitable. Such a chart in skeleton form, plotted from the Keenan and Keyes steam tables, appears in Fig. 3. The small key drawing indicates the meaning of the various areas bounded by the chart lines and shows the way the paths of the various fundamental thermal processes are plotted.

The important property of the chart from the standpoint of energy changes is that *areas* represent heat content. As shown in Fig. 4 *a*, *b* and *c*, the enthalpy, or total heat, in a pound of steam of any condition is made up of the sum of the increments of thermal energy above 32 deg. F. which are added to each stage in the operations of producing the steam from water initially at 32 deg. F. The areas represent this heat content and equal the average *absolute* temperature in each stage, times the change in entropy. As in Fig. 4 *d*, the difference in total heat between steam at two conditions is shown by the area under the path followed in changing from one condition to the other.

With this background it is possible to use the chart in visualizing various thermal processes and in showing how varying proportions of the energy put into the steam are recoverable as work in the different processes, while the remainder becomes unavailable, except for heating. The charts are simplified in that radiation and losses from friction are not taken into account. What they show is the theoretical maximum energy available for work or heating in the various processes, in relation to the total energy supplied, and to the unavailable energy that is rejected to the atmosphere, to the condenser, or to process heating.

With the exception of the Carnot cycle, Fig. 4 *e*, which is of purely theoretical interest, as the limit that can be reached by even a theoretical thermal process, all of the cycles shown are in actual use. For example the superposition cycle (*n*) has been applied to a considerable extent in recent years to permit modernizing for the production of a maximum of power at high efficiency, with the use of part of the old equipment. A new high pressure boiler and high pressure turbine are required, the new turbine exhausting to the old one. The old low pressure boiler can often be retained for standby use or for process steam. The method seems to have considerable possibility for process industries use.

EQUIPPING A POWER CYCLE

Power plants have become increasingly complex in the last two decades. The time-honored sequence of hand-fired boiler, engine, and exhaust to the atmosphere, has largely given way to the stoker or other mechanized fuel firing equipment, the steam generator, the turbine or engine and condenser, and all of the numerous auxiliaries for reducing labor, sav-

ing heat, insuring proper operation, and taking care of the flows of fuel and ash, condensate and feedwater, steam and flue gas. Included are some or all of the following: Equipment for handling and feeding fuel and removing ash; supplying and preheating combustion air; collecting condensate; treating, preheating, degasifying and pumping water for the boiler, and reducing boiler water solids content; removing entrainment from the steam and superheating it; extracting waste heat, cinders, soot and fly ash from the flue gas, and waste heat from steam supplied to auxiliaries; and checking and regulating combustion and all the various temperatures and flows. Still another factor in the case of plants with widely fluctuating steam (and sometimes power) requirements is often the use of steam storage in an accumulator.

Not all the heat in the fuel burned in a furnace can be transferred to water in a boiler, but high efficiency generating stations today do manage to recover as much as 90 percent of this heat in the steam under most favorable circumstances, while the average industrial boiler will extract 65-85 percent or even better. With solid fuels there will be a small unavoidable loss of unburned combustible in the ash, and with any fuel improperly burned, a loss in CO in the stack gases. Radiation will account for a small further loss, but by far the greatest part is heat wasted to the atmosphere in the flue gases. Flue gas must not be cooled to its dew point, for fear of condensation of its water, with consequent corrosion, but with this limitation, and that imposed by cost of low-level heat recovery, considerable saving in flue gas heat is possible. Most boilers today are provided with at least an economizer after the last pass of the boiler which, for every 11 deg. it heats the feedwater, improves the boiler efficiency by 1 percent. Many of the larger boiler plants, especially those used for power production alone, also install preheaters for the combustion air after the economizer. This is an especially valuable adjunct in a high-pressure, high-temperature boiler, since the high temperature of the feedwater imposes a limit on the recovery that can be made by the economizer, and the flue gas leaving the latter is necessarily at a high temperature. Boiler efficiency is increased by 1 percent for every 35-40 deg. F. by which the preheater reduces the flue gas temperature.

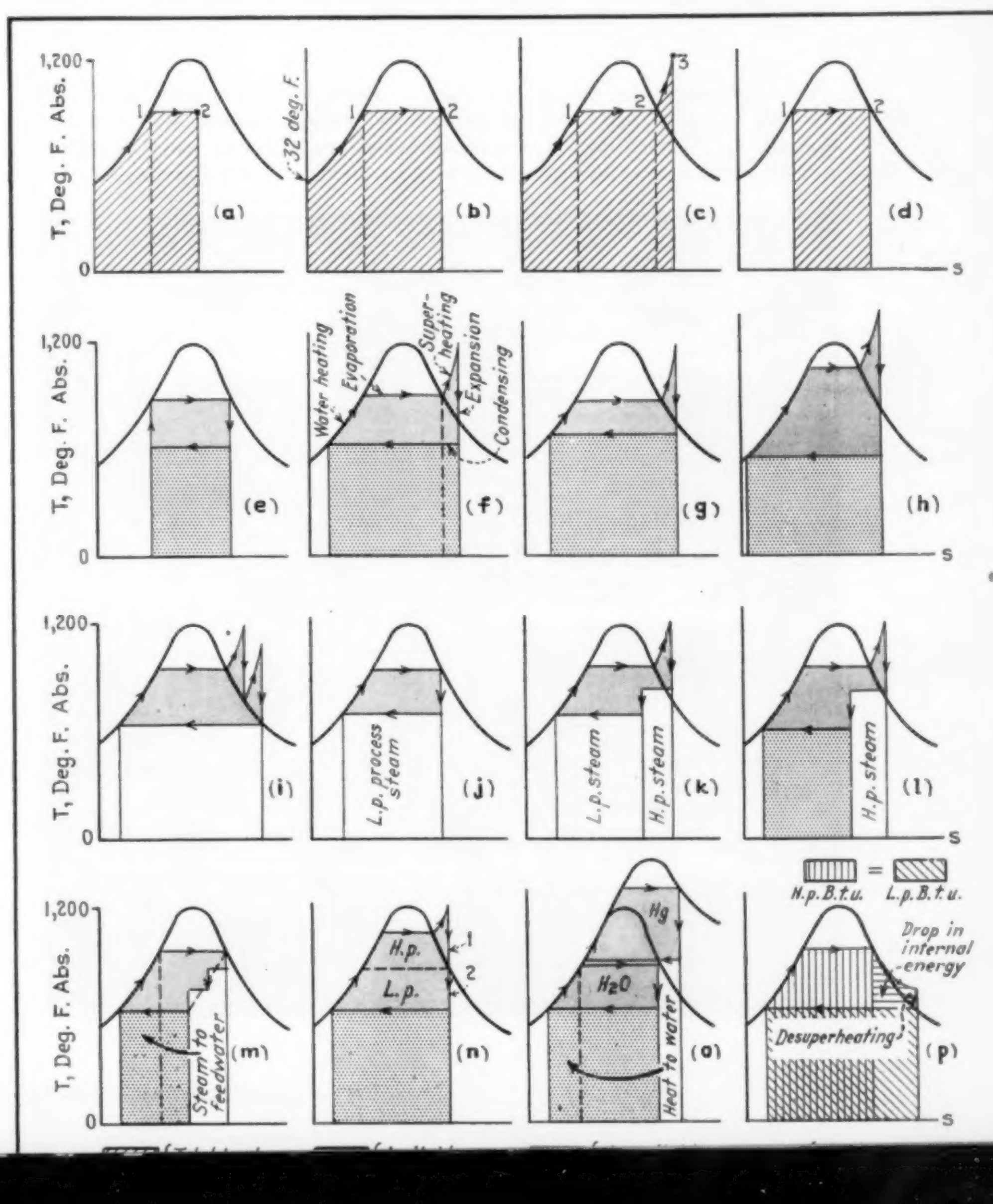
Another very important part of heat recovery is the feed water heater which ordinarily recovers low-level heat from the steam exhaust of various auxiliaries, from the boiler blowdown, and sometimes direct from the turbine in the regenerative cycle (Fig. 4 *m*), as noted below. Live steam, if waste heat is not sufficient, is also used for feedwater heating. As with economizers, every 10 deg. rise of water temperature in the feedwater heater means an added percent in boiler efficiency.

BOILERS

Boilers have grown tremendously in recent years, evaporative rates in excess of 1,000,000 lb. per hour having been attained in utility work. Although the old horizontal return tube (fire tube) boiler still finds economic

Fig. 4—Temperature-entropy chart used to show principles involved in various thermal processes and cycles

(a), (b), (c) and (d) Show how area indicates the total heat of steam of any condition. (e) Demonstrates the theoretical Carnot cycle of maximum theoretical efficiency for any range of working temperatures; the efficiency equals the "available" energy area divided by the total of available plus unavailable energy. (f) Shows theoretical Rankine cycle, with and without superheat; all vapor-engine processes are based on this cycle. (g) Shows undesirable result on engine capacity and efficiency of low top pressure and high back pressure. (h) Demonstrates desirable results of high top pressure and low back pressure. Note that the total heat may be less, but the availability greater at higher pressures. (i) Shows ordinary steam cycle with superheat, to which re-heating of the steam after partial expansion, and ahead of final expansion, has been added for slight extra capacity, but chiefly to avoid friction and erosion effects of wet steam in last part of expansion. (j) Back pressure engine or turbine exhausting to process heating, showing small amount of energy charged to work, large amount charged to process. (k) Non-condensing bleeder turbine discharging at two process steam pressures. (*Note:* Strict accuracy on this chart as well as chart (l) would require two charts to take care of reduced weight of steam expanding after bleeding.) (l) Bleeder turbine discharging process steam at high pressure and exhausting to a condenser. (m) Regenerative cycle in which steam bled at two pressures from the turbine is used in countercurrent heating of feedwater to approximate, as a limit with an infinite number of bleeds and water heaters, efficiency of Carnot cycle. (n) Superposition cycle (topping) in which steam from a new high pressure boiler passes through a new high pressure turbine, which discharges to the old low pressure turbine. (o) Binary cycle using mercury vapor in the first cycle, condensing in water boiler to form steam for the second (lower) cycle; note high efficiency and availability. (p) Reducing valve: steam expands down a line of constant total heat, increasing its entropy and decreasing ability to do work, but losing nothing from the heating standpoint during pressure lowering.



applications in small, low-pressure installations, particularly where a large steam storage capacity in the boiler is desirable to take care of brief overloads, boilers today are almost always constructed largely of banks of vertical or inclined tubes, all manifolded to headers or drums. Drums are still used almost entirely for this purpose in the United States, although abroad, drumless, forced-circulation boilers are being employed to an increasing extent. Modern boilers, sometimes even in small sizes, employ water-wall furnaces in which most of the combustion space is inclosed by tubes in which water is evaporated largely by radiant heat from the flame. In recent years the tendency toward increase in radiant surface with corresponding decrease in convection surface has been notable. Of course, it goes without saying that boiler pressures have tended to increase markedly, calling for better materials of construction, thicker tube and drum walls, and extensive use of welding in boiler construction. Although this trend is more notable in utility practice, still, many industrial boilers are now in the range above 600 lb. pressure with one, at least, as high as 2,500 lb. Temperatures, also, have been increased materially, with superheating to as high as 900-950 deg. F. Assuming that still better materials of construction become available, it is probable that temperatures will go still higher, possibly as high as 1,200 deg. F.

Gradual improvement has been made in all types of fuel firing equipment in recent years, but the most notable trend is toward the use of powdered fuel equipment in order to secure the tremendous heat release rates demanded of modern power plants. Coupled with this trend, however, has been a better realization of the place of the various stoker types so that now there is little likelihood that a plant will find trouble in burning any sort of fuel. A wise move, frequently, except where ability to continue using the same fuel supply is absolutely assured, is to make provision in the same boiler for more than one type of fuel firing to allow for contingencies. Today, for example, oil-burning boilers are sometimes equipped with reserve stokers or pulverized fuel equipment. Pulverized fuel boilers are sometimes provided with auxiliary fuel oil or gas burner equipment.

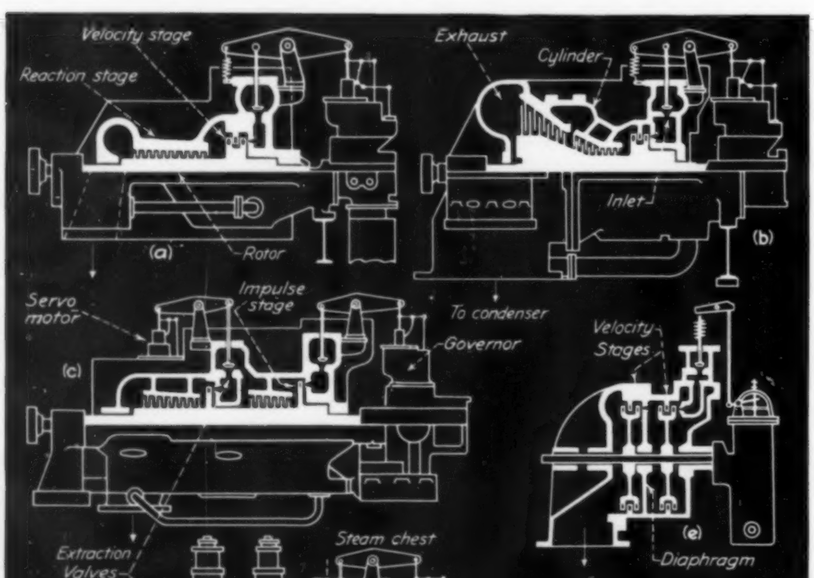
BOILER AUXILIARIES

Water Supply—In the higher pressure ranges, problems of caustic embrittlement, corrosion, silica scale on tubes, carry-over, and turbine blade encrustation are all encountered. Many such plants are employing evaporated feedwater as the simplest treatment under the circumstances, especially where condensate represents a large proportion of the feedwater. Usually evaporation is not found necessary for less severe conditions, but some form of water treatment is required in almost every case. Chemical water treating methods (see eight-page *Chem. & Met.* report on this subject, June 1941 issue) have for their purpose the removal of turbidity and suspended solids, and reduction in the concentration of dissolved solids. For the first, flocculation with alum plus settling and filtration are effective. Depending on the type of dissolved solids to be removed, processes such as the hot lime-soda process, sodium zeolite, and hydrogen zeolite methods are being employed, the last a rather recent development for reducing total dissolved solids by converting carbonates to CO_2. Silica removal processes have also become important. Particularly at the higher pressures dissolved gases, chiefly oxygen and CO_2, are bad actors in causing corrosion, and most water treatment schemes now provide for degasification.

These various methods are all carried out external to the boiler. Recently the old style internal treatment has been reviving, under scientific auspices, for the purpose of preventing the formation of hard, adherent scale by solids precipitating in the boiler. Such treatments generally use colloidal compounds, either organic or inorganic, with or without the addition of soda ash or sodium phosphate. Whatever the treating method, however, constant addition of new feedwater to the system results in a gradual build-up of dissolved and suspended solids, so that blowdown to maintain the solids concentration within limits is as necessary today as in the pre-treating days; with these differences: Intermittent blowdown is still practiced, in spite of the advent of continuous blowdown, but there is usually an attempt made now to recover the heat in the blowdown, either by flashing to steam for the feedwater heaters, or in surface heat exchangers. Some plants supplement the system with "deconcentrators" to reduce the amount of blowdown, a method of continuously recirculating a part of the boiler water through an external sludge trap to remove the suspended solids before the water returns to the boiler.

Caustic embrittlement continues to be a subject of argument. Originally blamed on a critical ratio of silica to total boiler water alkalinity, it was to be cured by maintaining a proper ratio of sulphate to alkalinity. The ratio was found to give too high a total solids content, with consequent foaming and carry-over. Fortunately, the boilers in which this trouble was encountered are mostly welded, so that evidently the strains and concentration cells present in riveted construction are absent, and embrittlement has not occurred after reducing the solids concentration.

Fig. 5—Diagrammatic sketches of turbine types: (a) Non-condensing reaction turbine; (b) Condensing reaction turbine; (c) Single-extraction non-condensing turbine; (d) Double-extraction condensing turbine; (e) Two-stage impulse turbine; (f) Diagram showing principle of single-wheel re-entry turbine



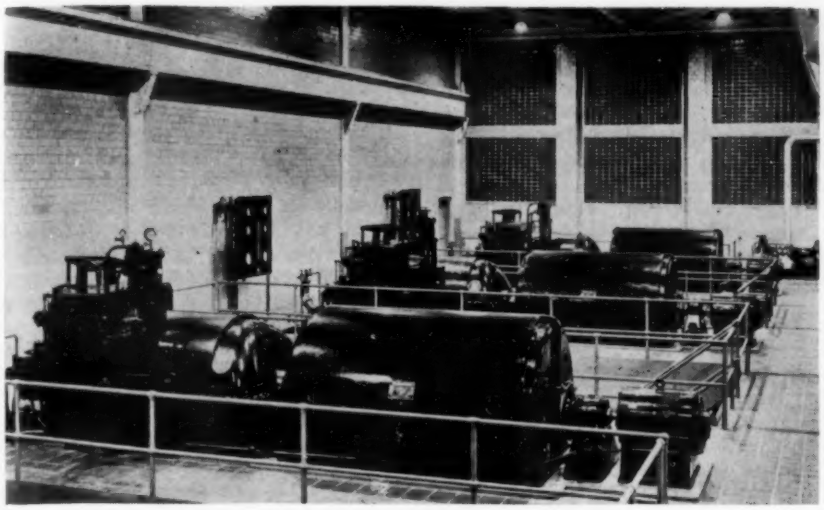


Fig. 6—Westinghouse 5,000 kw. single-extraction condensing turbo-generators, operating at 650 lb. and 750 deg. in Industrial Rayon's Painesville plant

Water Heating and Deaeration—Feedwater heaters are of two types, open and closed. The open type is inherently capable of deaeration, when properly vented, bringing the feedwater in contact in a closed vessel with exhaust or possibly live steam, by means of sprays, cascades or trays. The closed type is ordinarily a shell-and-tube or shell-and-coil heat exchanger. After the feedwater heater, most plants use an economizer, which is a tubular gas-to-water heat exchanger placed after the last boiler pass. Two distinct types are recognized: water heating and steaming. Two constructions are employed: either a design similar to a two-drum bent-tube boiler with substantially vertical tubes, or a nest of hairpin coils arranged horizontally.

Steam Washers—Increased foaming tendencies at high temperatures and pressures, as well as the high steaming rates of modern boilers, have increased the need for adequate methods of preventing water entrainment, and resulted in improved entrainment separators which are generally built into the boiler drum. Evidently one of the most effective methods is to employ both inertial effects and washing of the outgoing steam with incoming feedwater.

Air Preheaters—Surface type heat exchangers using either tubes or plates may be employed, and in addition, a regenerative type is also available. The first two differ little from heat exchangers employed for other gas heating. The regenerative type, as ordinarily constructed, consists of a drum containing cellular metal passages, so arranged that air can be drawn downward through the passages to one side of the median line, with flue gases passing upward through the passages to the other side. Seals are provided between the two passages to avoid mixing of the gases. As the drum rotates slowly, heat from the flue gases is imparted to the metal cell walls after which this heat is carried around into the air stream and given up to the cooler air.

Feedwater Pumps—In the lower capacity range, the usual practice is to employ reciprocating pumps for all boiler pressures. In the range from, say, 100 to 300 or 400 g.p.m., however, both reciprocating and centrifugal pumps are used while above this range, centrifugal types are almost universal. The centrifugals are necessarily of the multi-stage type. Numerous variations in design have been introduced in an effort to improve efficiency and balance the heavy end thrust at high pressures. Pumps are of the volute type for low to median pressures, say, to 800-1,000 lb. per sq.in. and of the turbine, or diffusion, type for higher pressures.

Condensers—Turbine condensers are always of the surface type, supplied with straight tubes. Improvements in methods of securing tubes to the tube sheets, and better tube arrangements, have characterized recent developments. On account of the enormous vapor volumes handled, steam condensers have tube arrangements which recognize the volume factor, and the decrease in volume as condensation proceeds.

Accumulators—Plants having large peak steam loads of relatively short duration can often save the expense of additional boiler capacity, and operate the existing boilers at a steady and therefore more efficient rate, through steam storage in an accumulator. An accumulator of the Ruths type is an insulated pressure vessel containing water, with a number of distributing nozzles through which steam in excess of the immediate requirements can enter, to be condensed in contact with the water and so store its heat in the form of superheated liquid. Through provision of the proper regulating valves, an accumulator will condense and store the excess when the line pressure tends to rise, and release steam when the pressure tends to fall on increased demand.

Fans—Modern high performance boilers are rarely operated on natural draft, not alone because auxiliaries such as the economizer and air preheater reduce the draft available, but because of the better control of air supply when fans are used. A variety of types of fans are used for this purpose, including radial blade fans, multi-blade fans and designs with either forward or back curved blades. Consideration of fan characteristics in relation to the type of service demanded is the determining factor. For control, discharge dampers are sometimes used, but are relatively inefficient. Control vanes in the inlet give better results. Sometimes variable-speed drive is used, either a variable-speed engine, or some form of mechanical variable-speed drive connecting the fan to the motor.

Gas Cleaners—To an increasing extent, public opinion has tended to force power plants to the use of equipment for suppressing fly ash, cinders and dust. Most commonly, the equipment used for this purpose is of the inertial type, either a fan-type precipitator, or a trap with sinuous passages for catching the larger particles, or some one of the modern forms of high efficiency cyclone. For highest performance Cottrell precipitators are used in some of the large stations. Recently there has also been interest in the use of wet-type nuisance suppressors including wet cyclones, wetted baffle plates and grid-packed towers.

Boiler Control—Modern boiler installations, particularly the bigger ones, are largely automatic in operation, not to relieve the operator of responsibility, but to assist him in securing optimum performance. Some of the factors requiring measurement and/or control are as follows: In connection with the fuel supply, in the case of coal, large plants often spot temperature indicators in the coal pile to guard against spontaneous combustion. Fuel weight must be measured to all boilers and the rate of supply controlled. In pulverized fuel installations, the temperature and pressure in the pulverizer are important in insuring proper burner operation. In connection with the air supply, both temperature of the air from the preheater and the rate of air flow are important. Furnace draft is measured at various points, as indicative of flow and also of changing conditions (such as build-up of obstructions) in the boiler. In connection with the water supply, feedwater temperature and pressure must be measured, feedwater rate controlled and boiler level adjusted within relatively close limits. As has already been indicated, boiler water composition control is also essential. Analysis and pH measurements may be necessary in this connection.

During combustion in the furnace,

furnace temperature is an important measurement, together with control of the completeness of combustion, as indicated by flue gas analysis. For this purpose, CO_2 measurements are generally made from samples taken from one of the last passes of the boiler. Various measurements are also necessary on the steam produced, including pressure at the boiler, pressure and temperature after the superheater, and steam flow rate from the boiler. Finally, to button up the control, flue gas temperature and composition must be known.

PRIME MOVERS

In deciding whether to employ an engine or a turbine, several factors have to be considered. Small engines of the non-condensing type are more efficient than small turbines so that in such a case, with a process steam load, engines will ordinarily be chosen. On the other hand, for larger loads, particularly where steam may be required at two or more pressures for process, turbines will ordinarily be used. Turbines have superseded steam engines entirely in the utility field, owing both to the considerable output required and to the fact that large turbines have an advantage over engines where cheap condensing water is available. This is not to say, however, that turbines are definitely indicated as the choice in cases where power is produced as a byproduct of process steam. Improved lubrication methods, eliminating oil from the exhaust, have been an important factor in advancing the smaller sizes of engine for this purpose. Engines have generally been limited to lower pressure operation, below 500 lb., but there appears to be no good reason why somewhat higher pressures cannot be designed for.

Another field for engines is in the driving of boiler room auxiliaries, such as stokers and draft fans. Some smaller plants with process steam loads and relatively small mechanical-drive requirements have made economical application of the old method of producing mechanical power with an engine exhausting to process, and transmitting this power to equipment by means of a line shaft and belting.

Engines—Design of steam engines has been well stablized for many years. Better materials, and refinements in control, lubrication and valve operation have, of course, been introduced, but the engine remains today fundamentally similar to its predecessors. Single-cylinder, double-acting vertical and horizontal engines are used to a large extent for auxiliary drives in sizes up to, say, 400 hp. For prime-mover service in driving generators, uniflow and four-valve engines are generally used, sometimes in vertical multi-cylinder designs similar in appearance to internal combustion engines. The multi-cylinder type is adaptable to bleeder service and in the vertical design takes less floor space, has lighter parts and can operate at higher speeds. Engines inherently are capable of operating at higher back pressures than turbines. Relatively low speeds compared with turbines, high starting torque and a full range of speed adjustability are outstanding engine characteristics.

Turbines—Widest development in steam power equipment has taken place in the turbine field. A turbine is a device for converting the kinetic energy of a jet of steam issuing at high velocity from a nozzle into mechanical energy. Two effects are responsible for this conversion, the impulse (momentum) action of the jet against the turbine blades, and the reaction (inertia) of the jet as its direction is changed in passing through the blades. Two different methods of utilizing the energy of steam are employed: impulse staging and reaction staging. In an impulse turbine, the total pressure drop of the steam occurs in a few stages, from one to ordinarily not more than three or four. In a single-stage impulse turbine all of the drop and expansion occurs in one set of diverging nozzles which impart a high velocity to the expanding steam. This velocity is then absorbed by the blades of a single turbine wheel. No pressure drop occurs in the blades.

In a reaction turbine the pressure drop is taken gradually along the length of the machine as steam passes through alternate rows of stationary and moving blades designed to act as converging nozzles, thus tending to increase the steam velocity. This velocity increase, however, is imparted to the moving blades so that the final effect is decreased velocity.

Still another method of imparting energy to the turbine is known as velocity staging. This is a modified case of impulse staging in which the steam passes through diverging nozzles, then in turn through a set of moving blades, a set of stationary blades to redirect the steam, and a second set of moving blades. All expansion takes place in the nozzle, the blades absorbing the velocity imparted to the steam. Most turbines today, both the impulse and reaction types, employ a velocity stage at the inlet end.

In general, reaction turbines are employed today for high capacity service, both in condensing and in non-condensing types. Impulse turbines, on the other hand, are employed for smaller energy output, as in the drive of pumps, fans, centrifugal compressors, and other auxiliaries.

Reaction Turbine Types—A turbine reduces the pressure and energy content of steam, and thereby produces mechanical energy at the shaft. About six different types of service are encountered, resulting in as many different types of turbine arrangement. In the first place, a turbine intended only for power production will exhaust to a condenser at an extremely low pressure, resulting in a large expansion of the steam and requiring a rotor much larger in diameter at the condenser end than at the supply end. Or the turbine may exhaust instead to process at a considerably higher pressure, requiring a rotor which increases only slightly in diameter from the supply to exhaust end. Thus the condensing and non-condensing types are the two broad divisions. However, either type may discharge a part of the steam after partial expansion, an operation known as bleeding, or extraction. Customarily extraction turbines are arranged to extract at either one or two points, although a larger number of extraction points can be had if necessary.

Two other principal variations are employed. One is known as the extraction-induction type. Circumstances in a plant may be such that at certain times steam is required at some pressure which can be produced by extraction from the turbine, while at other times, as for example when waste heat becomes available, an excess of steam at this pressure may be available. In such a case an extraction-induction turbine can be used. When steam at the process pressure is required, the turbine will automatically supply it from the extraction point. However, when the steam supply at process pressure becomes excessive and pressure tends to rise in the main, the turbine will take in the excess steam at the extraction point, utilizing it in power production and decreasing the high pressure steam requirements. A variation of this idea, known as the mixed-pressure turbine, inducts available lower pressure steam at some intermediate stage of the turbine and can operate on either high pressure or low pressure steam, or both. These two types are ordinarily condensing turbines.

DIESELS AND GAS ENGINES

So far in this report, only steam power has been considered. As additional sources of process energy, internal combustion engines are sometimes employed, particularly for standby generating service and where process steam is not required. Except in the case of relatively small plants, say, under 2,000 kw., the diesel appears to have little, if any, competitive advantage where power production is concerned. When the power is by-product, diesels cannot compete. Still, for standby purposes, and for locations where coal or utility power are expensive, diesels are definitely in the picture. Somewhat similar considerations are involved with the gas engine, although obviously only in the relatively few locations where cheap gas fuel is available can this type be considered.

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Machinery, Materials and Products

Chem & Met Process Equipment NEWS

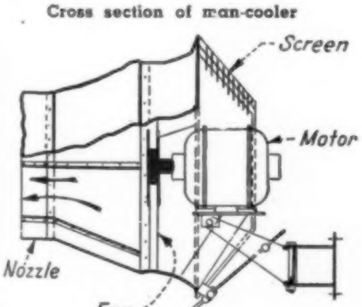
Improved Man Cooler

SPOT COOLING of men working in hot locations is the purpose of a new concentrated air-stream fan recently announced by the DeBothezat Ventilating Equipment Div., American Machine & Metals, Inc., East Moline, Ill. Known as the "Hy-V" air jet, the new cooler combines an axial-flow pressure fan with an aero-dynamically proportioned conversion nozzle in which the static pressure produced by the fan is converted into velocity energy. The fan wheel is said to operate always at peak efficiency, while curved radial vanes in the nozzle assist in producing an air stream of long, narrow jet effect, with minimum tendency to diverge. These fans are being built for both floor and wall mounting, in diameters from 18 to 30 in., for deliveries from 2,100 to 11,420 cu. ft. of air per minute.

Pneumatic Belt Carrier

DESIGNED especially for service under loading spouts and on belt feeders where the impact of heavy bulk materials is excessive, a new pneumatic roller for conveyor belt carriers has been developed and announced by Stephens-Adamson Manufacturing Co., Aurora, Ill. To cushion the impact of materials and thereby prolong conveyor belt life, the rollers in these carriers are made up of a series of pneumatic rubber units, 6 in. in diameter, and suggestive of miniature automobile tires. Much greater resiliency to shock and impact is claimed as compared with conventional carriers. The new rollers are mounted on a steel hub in which bearings and shafts are housed. Rollers have thick, wear-resisting treads and are inflated and permanently sealed to prevent loss of air. The new carriers are identified as the No. 711 pneumatic impact type.

Cross section of man-cooler



Pneumatic conveyor carrier

Rotary Industrial Pump

GENERAL INDUSTRIAL USE is the function of an improved rotary pump recently announced by the Blackmer Pump Co., Grand Rapids, Mich. While employing this company's basic bucket design, the new pump has been improved in various particulars to give increased quietness in operation and increase the life of the buckets from two to three times, according to the manufacturer. Streamlining of the inlet chamber permits the new pump to handle liquids of higher viscosity at rated operating speeds. The rated capacity of the pump, which is of the 2-in. size, is 50 g.p.m. at rated speed of 460 r.p.m., with maximum rated pressure for lubricating liquids of 110 lb. per sq. in., and for non-lubricating liquids of 75 lb. per sq. in. Viscosities ranging from naphtha to blackstrap molasses may be handled, according to the maker. Removable liners and strainers are optional equipment. Both single and twin pumps are available, for various types of drive.

Bulk-Flow Conveyor

CAPACITIES of from 1 to 140 tons per hour of granular or pulverized materials of non-corrosive and non-abrasive nature can be handled with the new Bulk-Flo conveyor recently announced by Link-Belt Co., 307 North Michigan Ave., Chicago, Ill. The new conveyor employs a closed trough in which is a specially designed chain, usually of malleable iron, to which solid peak-top flights are rigidly attached at every pitch. These flights divided the material in the conveyor duct into a continuous series of batches which are moved positively whether the load is full or only partial. Such conveyors are stated to be able to follow almost any desired path, horizontal, inclined, vertical or curvilinear, while any single self-contained unit may carry in all these directions in the same vertical plane.

Conveyors may be fed or unloaded at various points to suit conditions. Requiring only about one-fifth the cross section of a bucket elevator of corresponding capacity, the new conveyor is said to be extremely compact. Loading may be from bins, hoppers or chutes without flooding or overloading. One continuous conveyor may often serve where several units of other types would be required. Other advantages claimed include gentle handling of easily breakable materials, complete discharge, and self-cleaning action.

Loop-type, Bulk-Flo elevators

Insulating Firebrick

FOR TEMPERATURES in the range from 1,600 to 2,600 deg. F., Johns-Manville, 22 East 40th St., New York, N. Y., has developed a new line of insulating firebrick available in four temperature limits. These brick are designed for direct exposure in a wide variety of furnaces, ovens and other heated equipment, except when subject to slag action or mechanical abuse. Type JM-16 is recommended for exposed surfaces to 1,600 deg. F. or for back-up service to 2,000 deg. F. Types designed as JM-20, -23, and -26 are for exposed or backup temperatures to 2,000, 2,300 and 2,600 deg. F., respectively. The new line supplements this company's Sil-O-Cel series of back-up insulating bricks for temperatures of 1,600, 2,000

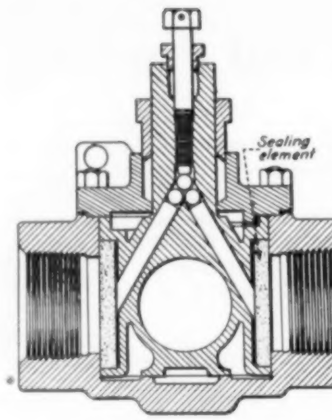
Insulating firebrick

and 2,500 deg. F. Such brick are produced from a plastic refractory clay and an organic filler which, upon being burnt out during manufacture, gives a uniform controlled pore structure, according to the maker, and imparts characteristics of light weight, high strength and high insulating value.

Cylindrical Plug Valve

An interesting design of non-lubricated plug valve, developed for use in the petroleum industry, is now being marketed in other fields by the manufacturers, Wheatley Bros., Tulsa, Okla. The new valve, which is shown in the closed position in the accompanying cross-sectional view, is made in sizes of 2, 3 and 4 in. for pressures of 175, 500 and 800 lb. Through the use of a mechanical seal, obtained by an ingenious method, lubrication is not required. The valve plug is cylindrical in shape, and contains in recesses two sealing elements, which may be made from a plastic such as Micarta, or any desired metal. When the valve is closed, the sealing elements are forced against the seat by mechanical pressure obtained by forcing the screw at the top of the stem downward against steel balls which transmit the pressure through rods to the seals. To open, the pressure is taken off the seals and the valve turned through 90 deg., giving a full-round, straight-through opening.

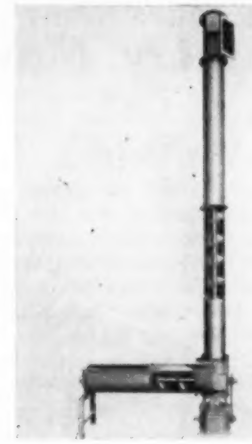
This company has also introduced a line of swing-check valves in sizes from 2 to 10 in., for pressures from 175 to 1,000 lb., in which the novel feature is the use of a synthetic rubber seat or ring to assure a positive seal regardless of grit, sand or foreign matter in the fluid being handled.



Non-lubricated plug valve

Vertical Screw-Lift

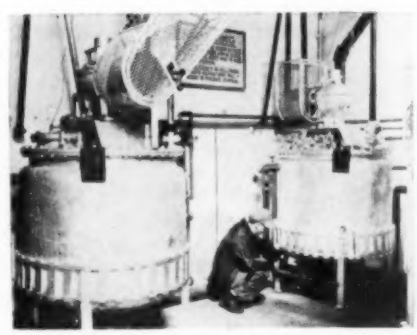
Elevation of bulk materials such as grains, seeds, ground limestone, cement, slack coal and similar solids is possible by means of a new vertical screw-conveyor recently introduced under the name of Hammond Screw-Lift by the Screw Conveyor Corp., 729 Hoffman St., Hammond, Ind. The new conveyor consists of a compact, dust-tight, moisture-proof vertical tube, containing a vertical helicoid screw, fed at the bottom by a horizontal screw. The conveyor may be driven from either bottom or top, by means of a totally inclosed lubricated drive unit, with forged steel cut-tooth gears, and roller bearings for all axial and radial loads. Power requirements are stated to be only slightly more than for bucket elevators of similar capacity.



Vertical screw conveyor

Jacketed Dissolver

An improved design of jacketed dissolver, designed for either heating or cooling of the ingredients, has recently been produced by L. O. Koven & Bro., Jersey City, N. J., for a pharmaceutical process involving the dissolving of metallic sodium. The design is suggested by the manufacturer for other operations such as dilution, extraction, leaching or mixing, where an all-welded container built in steel, stainless steel, copper silicon bronze, Monel metal or nickel can be used. The jacket is insulated and the mixer provided with a flat metal paddle mixer of U-shape, set so as to clear the bottom and sides of the vessel and permit withdrawing the contents while the mixer is operating. A quick-opening cover is provided.



New jacketed dissolvers

Electric Metal Spray

Metal spray guns have customarily employed a gas flame for melting the metal wire, and compressed gas to project the molten metal from the gun. A recent invention of M. U. Shoop of Switzerland, described as originator of the first metal spray gun, now does away with the use of compressed fuel gas, by melting the wire with an electric arc. The new Shoop Electro-Metallizing gun is now available in the United States and Canada from Herman A. Holz, 116-18 West 14th St., New York, N. Y.

The new Shoop process consists essentially in short-circuiting two conducting wires, atomizing the resulting drops of molten metal and projecting them by means of compressed air on to the surface to be metallized. A small luminous arc is formed at the breaking point, insuring continued melting of the wires which are fed forward by means of a turbine driven by the air supply. Owing probably to the highly ionized atmosphere and density of the metallic vapor in the arc, it is not extinguished by the air blast. Depending on conditions, the new process is said to be much faster than the old, sometimes even as much as 10 times faster. It is claimed that sandblasting of the surfaces to be coated can be dispensed with, owing probably to the much higher temperature of the particles when they are deposited. The process is stated also to be considerably less expensive to operate in that compressed fuel gas and oxygen are not required, the gun working on ordinary compressed air of 60 to 75 lb. pressure. Working with No. 18 B. & S. gage zinc or steel wire, the new gun requires 50 volts and 150 amp. a.c. or d.c.

Improved Coke Conveyor

Invented and patented by a coke-plant superintendent, an entirely new type of conveyor belt intended particularly for coke wharf service is being manufactured and sold by the B. F. Goodrich Co., Akron, Ohio. In coke wharf service severe abrasion occurs on only one-half the belt width and, with conventional belts, this half is worn out long before the other half. Abrasion rather than heat is the chief cause of wear, presuming that quenching is adequate. In the light of these facts, the new belt provides a double thickness of cover over the areas of greatest wear on both top and bottom of the belt. Thus, when abrasion wears down one side, the belt can be turned. The cover is made of a compound said to provide exceptional resistance to aging as well as abrasion.

Ventilating Fan

A new line of four-bladed ventilating fans known as the Ventura commercial type has been announced by American Blower Corp., 6000 Russell St., Detroit, Mich. The fan includes a steel wall plate with die-formed inlet, rubber-mounted fan bearings and either V-belt drive or direct drive. Fan

diameters range from 24 to 48 in., with the corresponding wall plate sizes from 31 to 60 in. The V-belt drive type is recommended for applications requiring extremely quiet operation. The direct drive is suggested for applications handling air containing excessive moisture, grease, steam or impurities and where noise is not a factor. Fans of this type with vapor-proof motors are listed for Class 1 Group D hazardous locations.

Fluorescent Lamp Lenses

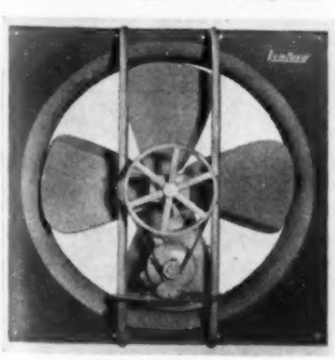
For producing controlled fluorescent lighting, the Holophane Co., 342 Madison Ave., New York, N. Y., has developed a series of prismatic glass lenses known as Fluorescent Controlenses. Three lenses are available, producing three basic light distribution patterns. The first, known as the intensive lens, produces normal "uniform spacing" lighting for horizontal surfaces in industrial interiors of normal height. The second, known as the concentrating lens, produces a rigidly defined focusing type of light distribution, as for general illumination from a greater mounting height. The third, or extensive lens, is said to be particularly suited for areas where lighting of vertical surfaces is desired, or in low-ceiling areas to permit economical wide spacing of units. Fixtures containing these lenses are available from a number of fixture manufacturers, made in types for flush, close-to-the-ceiling and suspension mountings.

New Starters

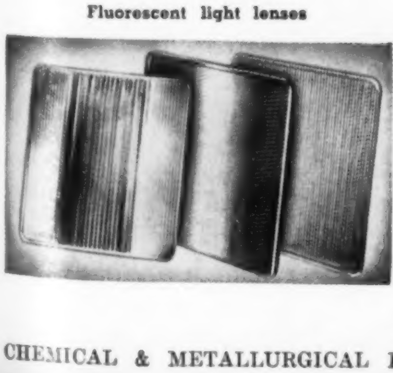
Two new starters have recently been announced by Allen-Bradley Co., 1311 South First St., Milwaukee, Wis. The larger one, a solenoid starter designated as Bulletin 709, Size 4, has been developed for a maximum horsepower rating of 50 hp. at 220 volts and 100 hp. at 440-550-600 volts. By employing the solenoid design, the size of the starter has been greatly reduced, compared with that of the clapper type starter which it replaces. The switch has only one moving part and is said to be simple in construction and free from complicated mechanism. Various types of inclosure are available, including weatherproof, dustproof and cases proof against hazardous as well as corrosive gases.

The second new type is a combination starter available in ratings from 2 hp. at 220-550 volts to 50 hp. at 440-550 volts. This starter is built in four sizes and designated as Bulletin 712. Combining a magnetic switch with a hand disconnect switch in the same inclosure is said to save wiring, insure greater safety for the operator and result in a compact installation of improved appearance.

Commercial type ventilating fan



Fluorescent light lenses



Equipment Briefs

For use in atmospheres containing explosive grain dusts, Century Electric Co., St. Louis, Mo., has announced a new explosion-proof motor which has been approved by Underwriters' Laboratories for Class II, Group G atmospheres. In the new motors, which feature improved appearance and greater protection, the cooling air is forced through large air passages surrounding the motor closure, at a velocity which is said to resist clogging and to keep the air passages clean.

Simplified welding is claimed as the outstanding feature of a new a.c. electric arc welder just announced by Ideal Commutator Dresser Co., 1344 Park Ave., Sycamore, Ill. Up to 15 different welding heats between 20 and 175 amp. are available, to give accurate heat and penetration control. A reactance winding designed to act as a stabilizer is said to make striking and holding an arc easy. Two voltages, 45 and 70 are used. The standard welder operates on 230 volt, 60 cycle current, employing welding rods from 1/16th to 5/32d in. diameter. Primary current varies from 1.75 amp. at no load to 52 amp. at full load.

New solenoid starter

A recent development of R-S Products Corp., 4530 Germantown Ave., Philadelphia, Pa., is an improved butterfly valve in which internal parts are machined to assist operation and obtain a tight fit between housing and vane. The line includes standard sizes from 2 to 48 in., for working pressures to 15 lb. A feature of the design is a pair of adjustable stops provided to stop the vane in either of two set positions between open and closed, to permit constant duplication of any set maximum or minimum opening. A graduated dial for spotting location of the vane is provided. Either handwheel operation through a self-locking worm and quadrant, or hand-lever operation may be employed.

A new application of the airfoil section used in modern airplane wings is in the deep-well and propeller pumps manufactured by the Peerless Pump Division of Food Machinery Corp., 301 West Avenue 26, Los Angeles, Calif. The use of the airfoil design is said to have shown considerable improvement, imparting higher efficiency and better pump life. While the thicker vane sections are said to increase first cost somewhat, performance and life improvements are claimed to much more than warrant this increase.

Elimination of pulsation of pressure gages and reciprocating pump governors is the function of a new gage snubber known as the Campbell Micro-Bean, manufactured by the J. A. Campbell Co., 645 East Wardlow Road, Long Beach, Calif. The new snubber comprises a small fitting in which is a filter and a taper-plug needle valve with an extremely slight taper for sensitive control of the shut-off. This micrometric control enables the operator to select the desired opening with extreme accuracy. Any scoring of the valve which may eventually take place can be ground out by shutting off the valve completely two or three times.

For use in industrial plants generating their own lighting current at voltages above 110, the Wabash Appliance Corp., Brooklyn, N. Y., announces a new high voltage Birdseye lamp made in six sizes from 100 to 1,000 watts and in 7 different high voltages from 220 to 300 volts. The new lamp has an interior silver reflector and a nickel neck reflector disk to redirect light which would ordinarily be wasted through the neck of the bulb.

A recent announcement of Johns-Manville, 22 East 40th St., New York, N. Y., describes a new method of constructing walk-in dryers and ovens,

tunnel ovens and lehrs, employing Marinite, a combination structural material and insulation which can be worked with carpenter tools in the same manner as wood. Panels consisting of one or more sheets of Marinite are used, completely eliminating the need for a steel casing. The material is stated to have a thermal conductivity in B.t.u. per sq.ft. per deg. F. per inch of thickness of 0.57 at 200 deg. F. and 0.65 at 800 deg. F. It is a solid homogeneous sheet made of asbestos fiber with an inorganic binder, available in thicknesses from ½ to 1 in., in sheet sizes from 36x96 to 48x120 in.

A RECENT ANNOUNCEMENT from Allegheny-Ludlum Steel Corp., Pittsburgh, Pa., states that the integral-bonded, alloy-lined plate which it manufactures under the trade name of Pluramelt has been approved by the Boiler Code Committee of the American Society of Mechanical Engineers for use in the construction of fusion-welded unfired pressure vessels. The ruling extends the list of acceptable armor or liner materials to include nine standard corrosion-resisting chrome and chrome-nickel alloys, and removes previous restrictions on inclusion of armor thickness in design calculations.

GAST MFG. CORP., Hinkley St., Benton Harbor, Mich., is marketing a new streamlined design of air pump with direct-connected 1/12th hp. motor for both vacuum and pressure service. The pump is of the rotary type, operating without gears, springs or valves, and is said to be of high efficiency, vibrationless and quiet in performance. Pump and motor together measure only 8½ in. long by 4½ in. in diameter, the air capacity being 0.5 c.f.m.

REPAIR of holes, ruts and worn places in concrete floors is said to be facilitated by a new material known as Floor-Patch, recently announced by Truscon Laboratories, Detroit, Mich. The new material is non-shrinking and is said to adhere tightly to the surrounding concrete surface. It is cementitious in nature, containing no tar, asphalt or portland cement. Suitable for overnight repairs, the material is stated to set eventually harder than the concrete itself. Only water need be added at the time of use.

HUBBELLITE is the name of a new floor surfacing material recently developed at Mellon Institute of Industrial Research, which has been put on the market by H. H. Robertson Co., 1938 Winslow St., Pittsburgh, Pa. This material is a cement containing copper which prevents the growth of molds, such as that causing "athlete's foot." It also has the property of conducting electricity so as to prevent the accumulation of static charges. It is believed by the manufacturers, therefore, that the new flooring will be a valuable adjunct to explosives plants and those making and handling flammable and explosive solvents, etc.

HOMOCORD is the name of a new type of rubber conveyor belt recently announced by Manhattan Rubber Mfg. Div., Passaic, N. J. Offering the flexibility of cord construction and ability to hold metal fasteners equally as well as fabric construction, the new belt is said to contribute to increased life and tonnage capacity. A new type of cord is combined with a new body construction designed particularly for conveyor belt use, and not at present intended for, or applicable to, other rubber products such as transmission belts.

Round-Chart Potentiometer

DEVELOPMENT of a circular-chart potentiometer pyrometer having an entirely new balancing device for the null-point potentiometer mechanism has been announced by the Brown Instrument Co., Philadelphia, Pa. The balancing system of the new instrument is continuous. It has no galvanometer and is said to be unique in speed of response and sensitivity to minute temperature changes. Balancing is accomplished by a brushless, reversible induction motor with built-in gear reduction which has ample power, according to the manufacturer, to drive the pen, pointer and slide wire. The rectangular case is tightly sealed against corrosive atmospheres. An 8-in. pointer indicates on a concentric 320-deg. circle, carrying 1-in., easily read numbers. A 12-in. chart is employed.

Ratio Controller

HIGH ADAPTABILITY and easy conversion are claimed for a new instrument designed for the control of temperature, pressure, rate of flow or liquid level, in a desired ratio to another related variable. This is now being offered by the Taylor Instrument Cos., Rochester, N. Y. The new ratio controller is direct-setting, the ratio being changed by a simple screwdriver adjustment directly on a calibrated dial. The ratio can be changed throughout the range of 0:1 to 3:1, direct or inverse. It is unnecessary to disturb the processing or remove the chart plate in making ratio adjustments. The new controller has two measuring systems, one the adjusting system which indicates or records only; and the other, the controlling system which may either indicate or record. The adjusting system resets the control point of the controlling system through a linkage arrangement according to a predetermined ratio. The action of the control system is the same as this company's No. 120 R series Fulscope and may be used as a single-duty bi-recording controller when the ratio setting is zero.

Potentiometer pyrometer

Chart Tear-Off

A NEW TYPE of strip-chart tear-off device, developed by C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y., is available for Celectray recorders and recorder-controllers made by this company. This consists of a tear-off bar and a reroll with clip and tape. The clip, of a special design without springs, firmly grips the chart after a chart section has been removed. The new feature is claimed to be particularly useful for daily records, as well as for a complete record of a single batch or run. Short chart strips are easily filed for ready reference. The new feature provides for a minimum of chart waste. When daily records are required, a special chart can be furnished with hour markings and sufficient space to allow for resetting on the correct time line.

New ratio controller

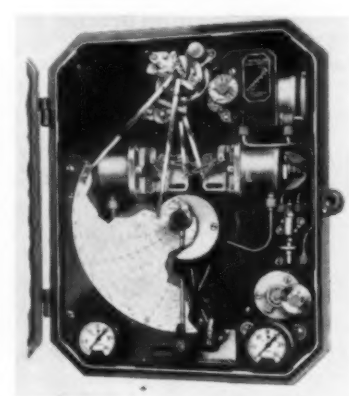
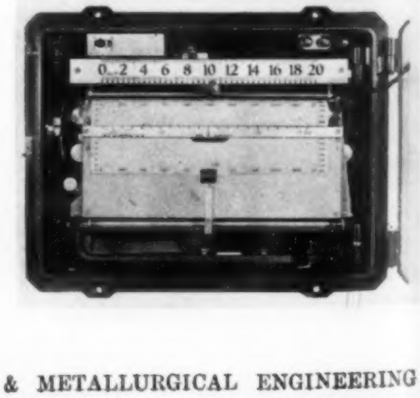


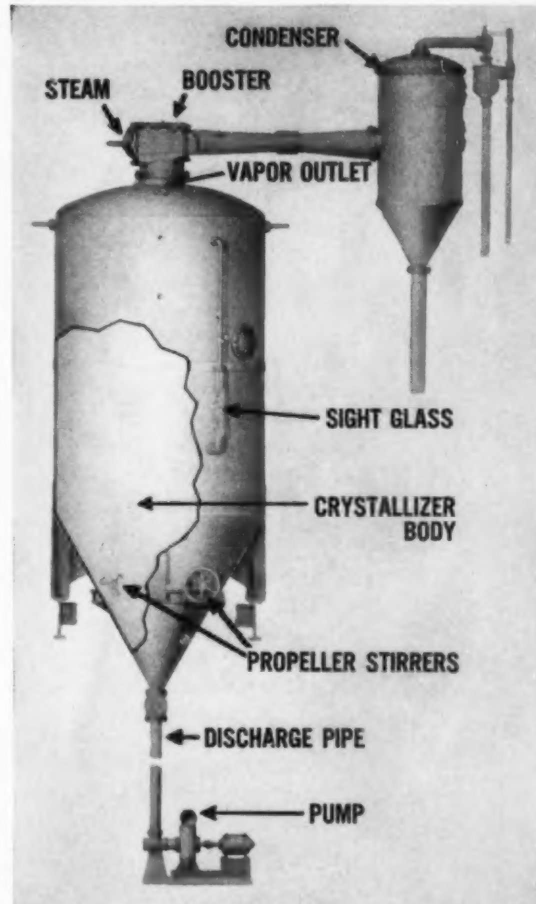
Chart tear-off device



FACTS YOU NEED TO KNOW ABOUT . . .

Vacuum Crystallizers

For the efficient low cost crystallization of many solutions, particularly under corrosive conditions



The vacuum crystallizer is used to cool solutions by evaporation in a vacuum and thus crystallize the solids out of solution. Because of its simplicity of design and over-all economy, it has become by far the most popular crystallizer in use today. It is particularly suited for handling large quantities of solution. It has furthermore proved of tremendous value in crystallization from acid and other corrosive solutions.

ADVANTAGES

Except for small capacities (several thousand gallons of solution daily), the vacuum crystallizer has a 40% to 50% lower first cost than mechanical crystallizers. In addition, its operating costs run some 30% to 40% less. With the exception of the propeller-type agitator, the vacuum crystallizer contains no moving parts. Hence, maintenance costs are low and its availability is high.

Since the vacuum crystallizer has practically no moving parts, it can be completely rubber-lined so that no metal parts contact the solution or vapor. Thus, when a crystallizer for acid solutions is required, the vacuum crystallizer is particularly applicable.

Where space is at a premium, the vacuum crystallizer is also at an advantage because it requires relatively small floor space.

LIMITATIONS

There are a number of applications to which vacuum crystallizers are not well suited. Among these are situations where the magma densities are too great to circulate freely. Heavy densities limit the rate of discharge and make it impossible to present fresh solutions to the vapor-liquor boundary for further cooling.

Although it is possible, through the use of steam jet ejectors, to produce very low temperatures and therefore high yield with the vacuum crystallizer, temperatures generally do not go as low as can be produced in the mechanical crystallizer using a refrigerated cooling medium.

Vacuum crystallizers also invariably require more headroom than mechanical types and this is sometimes a limitation.

APPLICATIONS

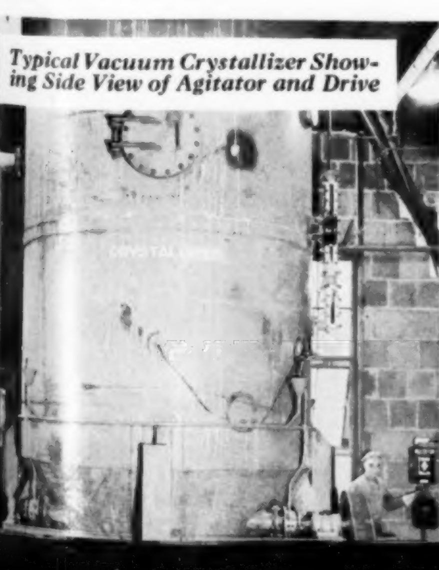
Up until a few years ago, the only vacuum crystallizer installations in this country were used for producing potash and borax in a western plant. Today, however, commercial installations are operating on copperas, Glauber salt, Epsom salt, ammonium sulfate, ammonium chloride, sodium potassium ferricyanide, ammonium fluotitanate, zinc sulfate, citric acid, and various other organic chemicals.

Swenson offers vacuum crystallizers of the batch and continuous type, with or without boosters. These can be built in steel, rubber-lined steel, nickel, nickel-clad steel, stainless steel, stainless-clad steel, and lead-lined steel. Write for complete information.

PRINCIPLE OF OPERATION

The solution is fed into the crystallizer body, where a steam jet booster maintains a vacuum and causes boiling. As the vapors are boiled off, the solution is cooled, causing the dissolved solids to crystallize out. The cooled solution and suspended crystals are removed by the discharge pump.

Typical Vacuum Crystallizer Showing Side View of Agitator and Drive



SWENSON EVAPORATOR COMPANY

Division of Whiting Corporation — *15669 Lathrop Ave., Harvey, Ill.*

SWENSON

CRYSTALLIZERS

FILTERS • EVAPORATORS

Sulphite Pulp

Now that this country is cut off from foreign sources of sulphite pulp, domestic supplies have taken on greater importance. One of the newest mills producing unbleached pulp is at Everett, Wash. It is a unit of the Pulp Division of Weyerhaeuser Timber Co. The accompanying pictures illustrate some of the essential stages in the process in use in this mill. The drawing is a flow-sheet of a typical sulphite pulp mill.

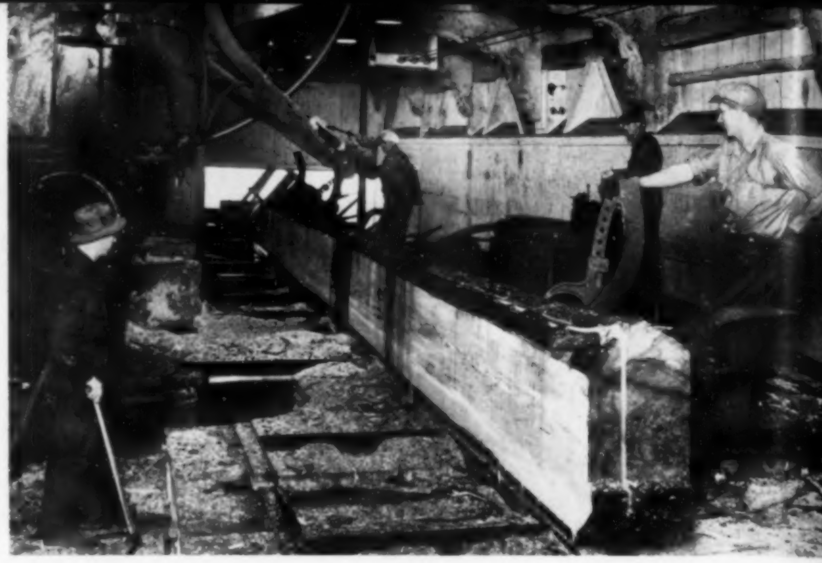
The basic principle of sulphite pulp production has undergone practically no change in more than 50 years. But during that time, and to an exceptional degree in the past few years, a large number of refinements and improvements have been made.

At the Everett mill hemlock logs are chipped and cooked in digesters with a solution of calcium bisulphite in sulphurous acid and steam. In this treatment the cellulose fibers are freed of ligneous materials and certain other constituents of the wood. When the cooking is completed chips are discharged into blow-pits, breaking the softened wood into individual fibers. The spent cooking liquor is drained off and the fibers washed.

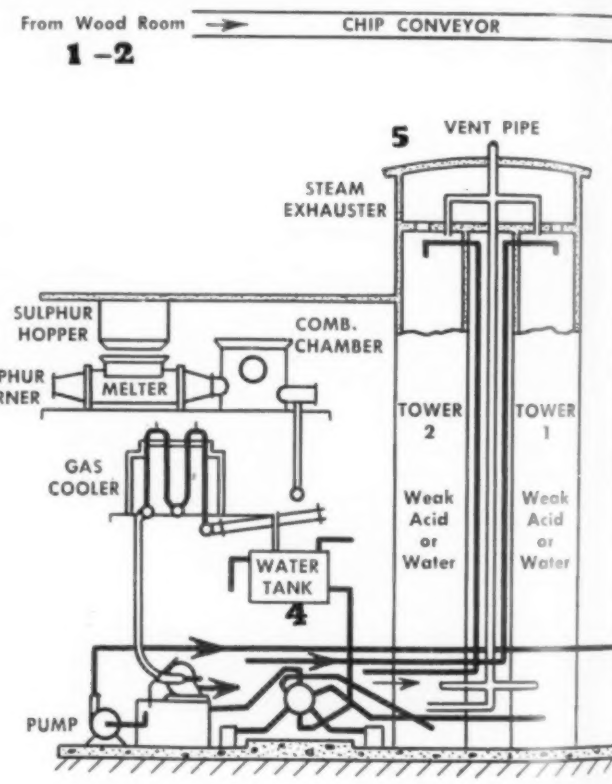
The fibers in water suspension flow by gravity to knotters, narrow flumes lined on the bottom with rows of slots, in which the knots are removed. The suspension then flows to rifflers where the nap of the felt lining on the bottom ensnares the foreign particles. Riffled stock, overflowing several dams, spills onto chromium plated screens. It is next thickened and directed to storage tanks, where it is held in readiness for the drying process.

Pulp drying begins with the overflowing of stock from a head box, where consistency is held at one percent. Suspended fibers flow evenly onto the top side of the fine mesh wire of the drying machine. As water drops through the wire, fibers remain on top to form a thick sheet of wet pulp. The sheet is further dried by press rolls and in a vacuum chamber. The dried, continuous sheet emerges and is cut in oblong pieces of uniform size. These are baled and are ready for shipment.

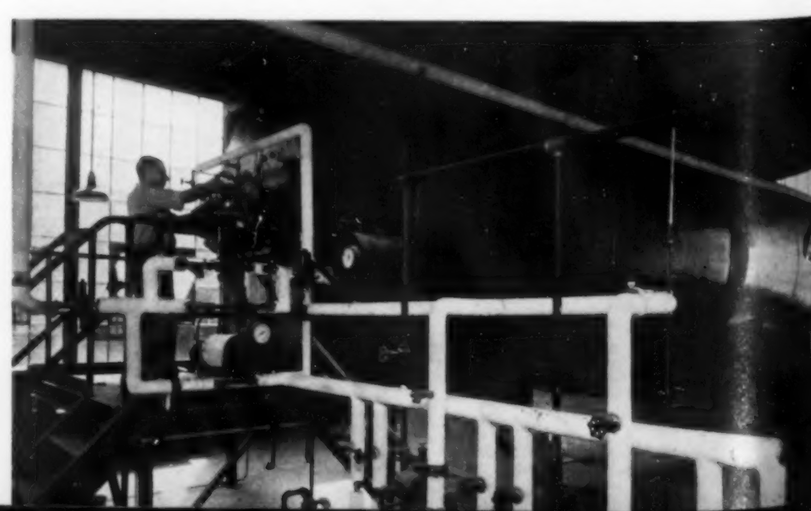
A *Chem & Met* **FLOW SHEET**



1 Hemlock log is hoisted from pond and placed within reach of head-rig, a saw which reduces every log into cants in a succession of lengthwise cuts



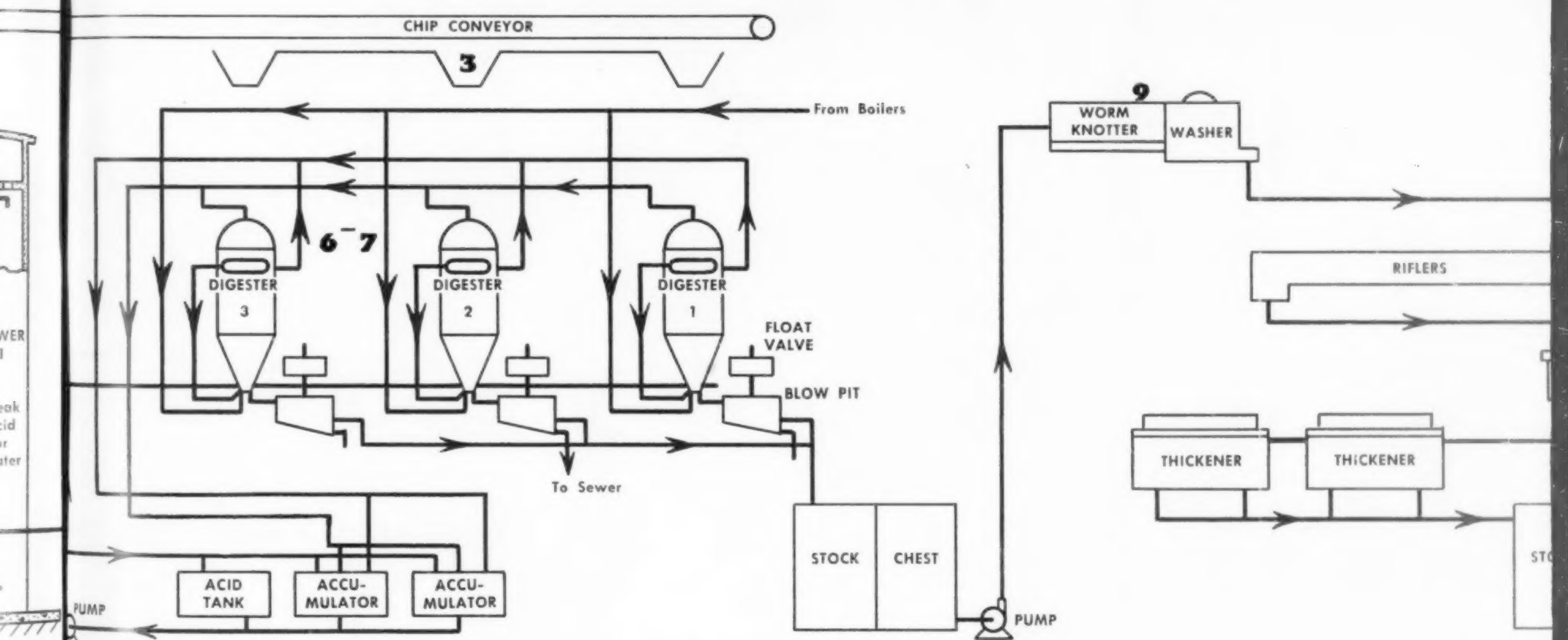
4 Sulphur spray burner used in preparing cooking liquor. Inside the burner the temperature is held around 1,300 deg. C. Liquid sulphur burns continuously



a saw

...ips are made from cleaned cants that drop down steel chutes to three chippers. ...ips are screened on oscillating screens shown here

3 From the oscillating screens chips are conveyed to storage building. Drawn from storage chips are fed onto a conveyor which takes them to digesters

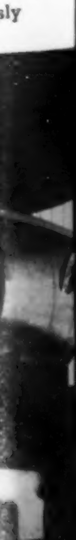


...urner the ...sly

...lphur dioxide is absorbed by water ...l acid towers 112 ft. in height

6 Digesters before housing was applied. A digester is filled with more than 50 tons of chips in 15 minutes

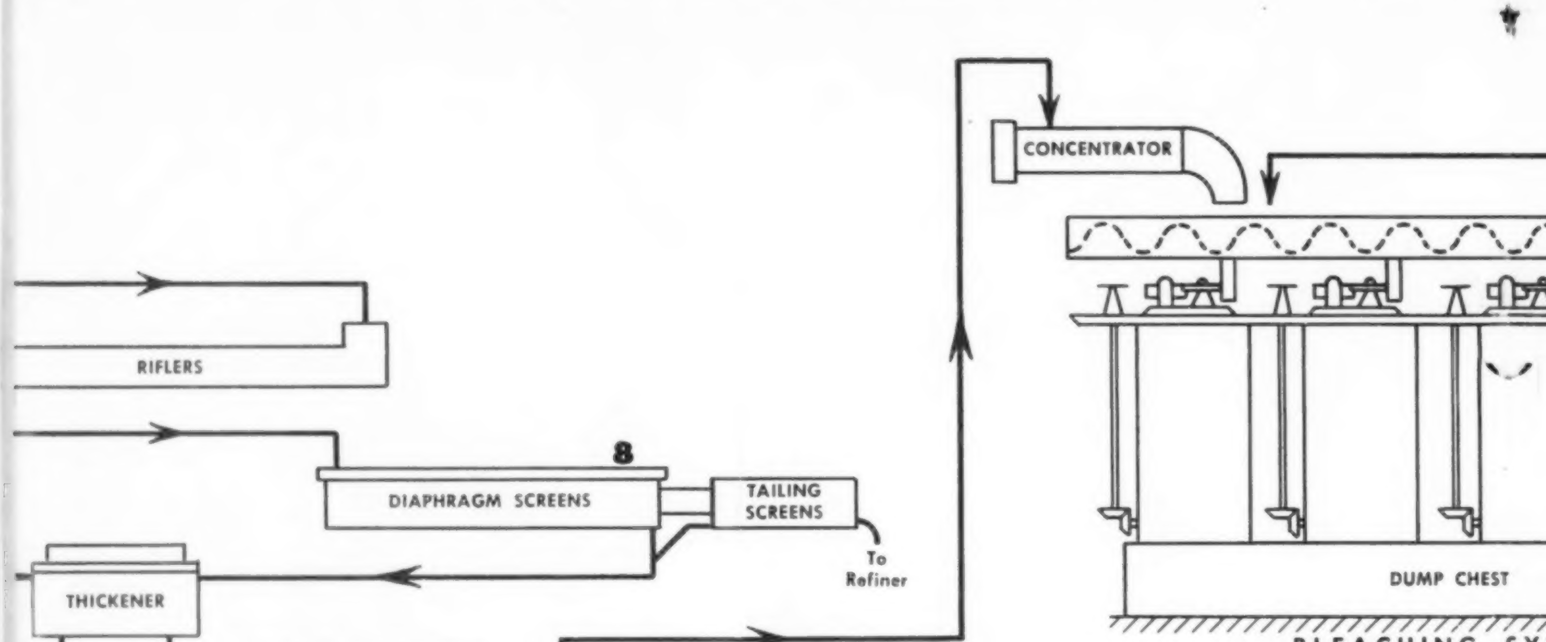
7 Top of a digester. Ligneous materials in the wood are dissolve... constituents by the cooking liquor leaving a residue of cellulose fi...

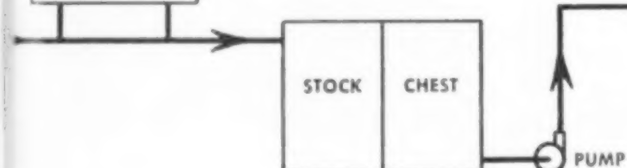


ıge building. Drawn
ı to digesters

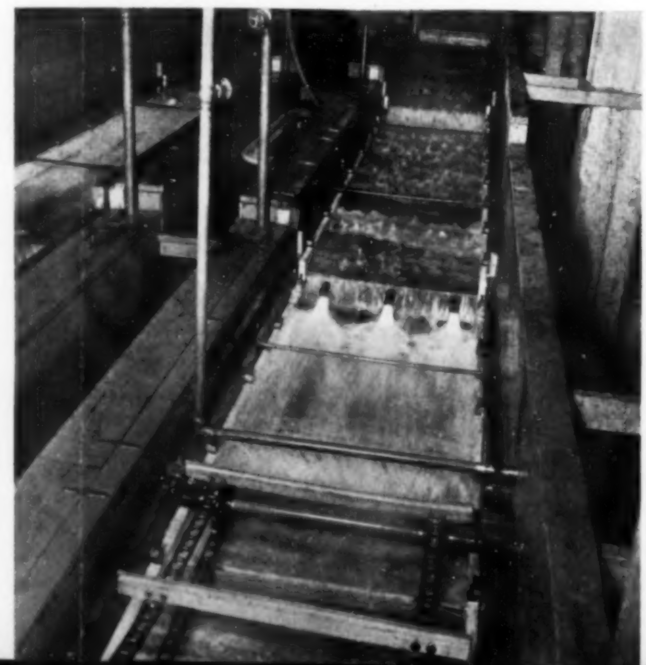
8 Acceptable fibers and water flow through slots in the screens. The screens are equipped with chromium plated screen plates, each with slots

10 Wet end of drying machi
overflowing of stock from a he

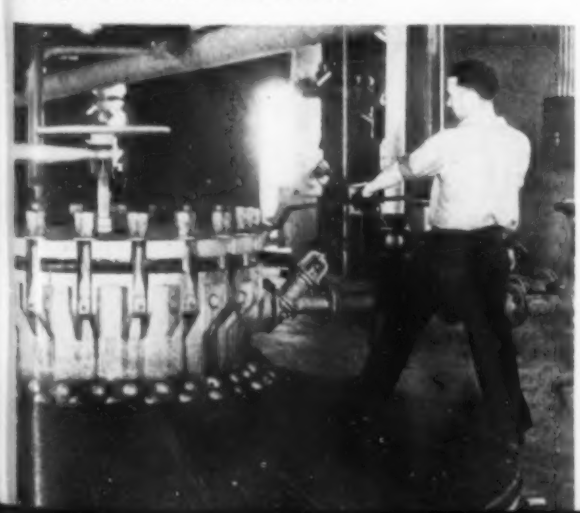


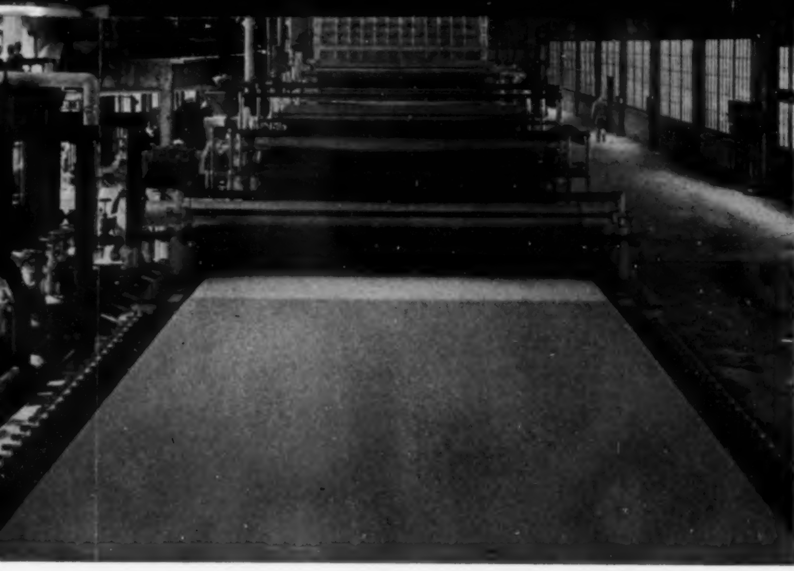


9 Screening out of knots is accomplished by running a water suspension of pulp down flumes lined with slots



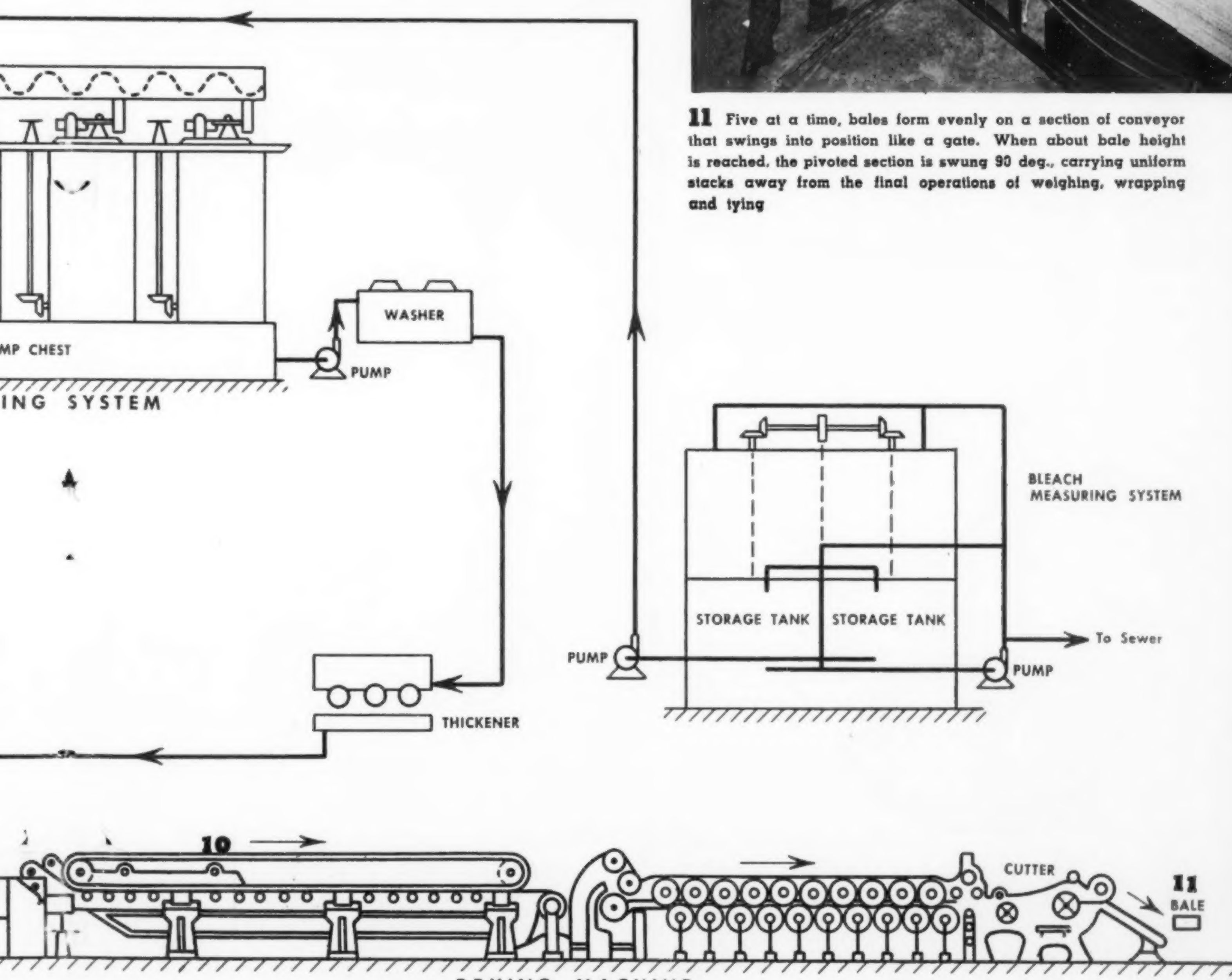
terials in the wood are dissolved, along with other
eaving a residue of cellulose fibres



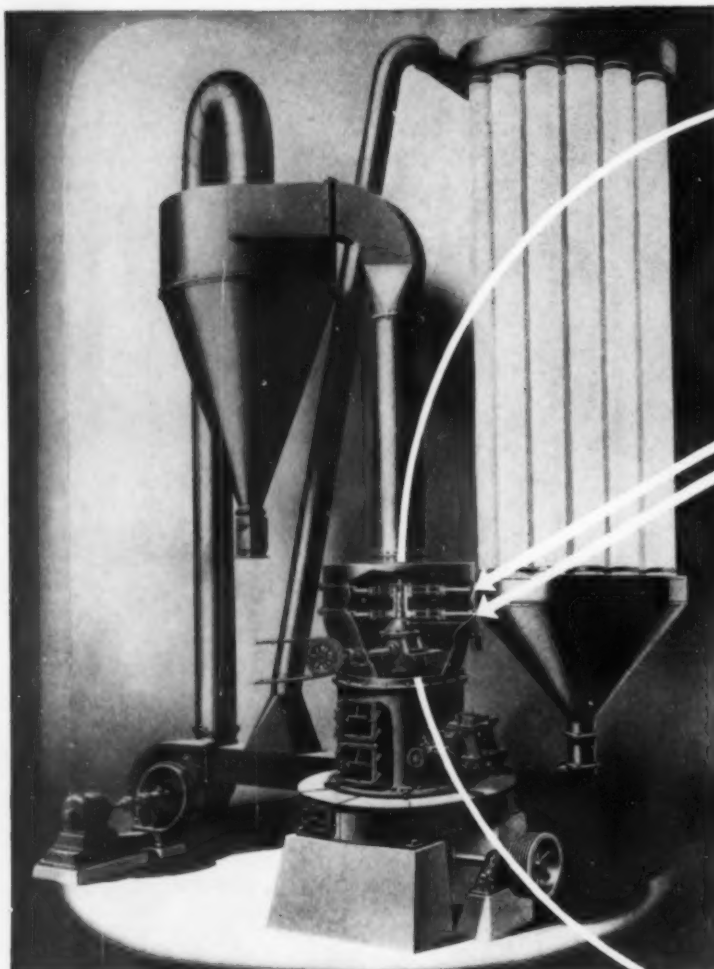


drying machine as seen from head box. Pulp drying begins with the
tock from a head box. Fibers flow evenly onto top side of wire

11 Five at a time, bales form evenly on a section of conveyor that swings into position like a gate. When about bale height is reached, the pivoted section is swung 90 deg., carrying uniform stacks away from the final operations of weighing, wrapping and tying




DURCO
DURIMET



Technical, Industrial, Personal

TAPPI FALL MEETING WILL BE HELD AT ANN ARBOR

Members of the Technical Association of the Pulp and Paper Industry have selected the campus of the University of Michigan at Ann Arbor as the scene for the fall meeting of the association which will be held Sept. 16-19. Room accommodations will be in the residence halls of the University. Members traveling from the east may be interested in taking the overnight cruise from Buffalo to Detroit. If a sufficient number take this cruise, buses will meet the steamer at the Detroit dock and go direct to Ann Arbor.

Registration will open on the morning of Sept. 16 and the first general session is called for 9 o'clock in Rackham Lecture Hall at which Dean Crawford of the University of Michigan will welcome the association and W. H. Swanson, president of TAPPI will respond. The early sessions will be devoted to problems of the industry under present unsettled conditions. Later on, technical sessions including topics such as pulp bleaching, coated papers, surface sizing, pigments, and materials of construction, will be important in the program.

Mills in Kalamazoo, Detroit, Ypsilanti, and Port Huron will be visited and on the final day of the meeting a visit is scheduled to the Ford Motor Co. and to Greenfield Village, Dearborn.

Arrangements for the meeting are under the direction of R. A. Hayward. Kalamazoo Parchment Co., W. K. Kidder, Allied Paper Mills, and D. W. McCready, University of Michigan.

NEW LABORATORY FOR BATTELLE INSTITUTE

The fourth major building expansion program in recent years is under way at Battelle Memorial Institute, Columbus, Ohio, where a $160,000 addition to the process metallurgy laboratory building is under construction, Clyde E. Williams, Institute director, has announced. Additional space for enlarged research programs concerned with the study of chemical and metallurgical processes on a pilot-plant scale will be provided for when the new structure is completed.

The expansion is the result of a continued increase in the Institute's research for industry, particularly in the fields of coal preparation, raw materials beneficiation, hydrometallurgy, pyrometallurgy, electrometallurgy, and foundry practice.

Because of current world conditions and the resultant emphasis on the development and ultilization of domestic raw materials and substitute materials, research by American industry has greatly increased, Mr. Williams stated. Current research investigations at Battelle are instituted partly by industries closely associated with the defense program and partly by those industries that are anticipating the adjustments of the post-emergency period with new and improved products and reduced production costs.

The new structure will be 70 feet by 105 feet in plan, with five full floors, and will provide 35,000 square feet of additional space. Its steel, brick, and concrete construction will conform with that of the other Institute buildings. Office-laboratory facilities are planned for fifty additional research engineers and technicians.

REDUCTION PROPOSED IN NUMBER OF PAINTS AND COLONS

A reduction in the number of colors of paints and varnishes and specific packaging recommendations are suggested in a proposed revision of Simplified Practice Recommendation R144, submitted to the paint and varnish industry by the National Bureau of Standards.

Details of the proposed revision were worked out at a recent joint meeting of the Standing Committee in charge of reviewing and revising the existing Simplified Practice Recommendation and the Simplification Committee of the National Paint, Varnish and Lacquer Association.

The revision proposes to reduce the number of colors of oil paints, enamels, varnishes, etc., included in the current issue of the recommendations, from 218 to 153, or 30 percent, and number of colors for water-mixed paints, from 127 to 101, or 20 percent.

Of particular importance is the recommendation to eliminate the half-gallon can and 30-gallon, or half drum, both of which it is felt should be discontinued in order to reduce the number of different containers that must be used for paint products, and in order to conserve steel and tin, so urgently needed for defense purposes. Paint sold in half-gallon cans represents only 9½ percent of the total gallonage, according to the committees' estimate.

ANTI-FREEZE SHORTAGE FEARED BY WASHINGTON

Shortage of anti-freeze next winter is certain to be serious unless new supplies of typical organics for these purposes can be developed. OPACS is working from the standpoint of civilian supply because OPM has taken for defense uses all available alcohol and methanol. Some glycol anti-freeze will be available because it is already in the distributing systems in small containers. But little more of that valuable chemical can be prepared and used in this application after the initial supplies are gone.

Whiskey distillers have been asked to make more industrial alcohol. New production from petroleum by important refiners is contemplated. Even makeshift methods for production of methanol are talked about, and may materialize.

Obviously no more shipping for bringing molasses for alcohol usage is contemplated. Boat space is too precious. Hence other raw material, more characteristic of beverages than industrial alcohol, may be necessary.

A two-price system may have to be deveeloped in order to stimulate new output as a temporary expedient. The government does not wish all alcohol and methanol prices to advance, as this would burden the defense program.

CALCIUM-SILICON PLACED ON PRIORITY LIST

Calcium-silicon, used for the treatment of certain high-grade steels needed for defense production, was put under full priority control on July 28 in a General Preference Order signed by E. R. Stettinius, Jr., Director of Priorities. The order requires consumers of calcium-silicon to file reports with their suppliers when placing orders, and states that the Director of Priorities will issue instructions for the allocation of all available supplies to customers.

At the present time there is only one producer. This company's monthly production is considered insufficient for all defense and civilian needs. Scheduled deliveries of calcium-silicon may be made during August as planned, but deliveries thereafter, beginning with September deliveries, can be made to consumers only in accordance with instructions from the Director of Priorities. Defense orders for calcium-silicon must be accepted by producers in preference to non-defense orders.

SOLVAY PROCESS CO. WILL MAKE SYNTHETIC PHENOL

The Solvay Process Co., subsidiary of Allied Chemical & Dye Corp., will construct a plant at Syracuse, N. Y. for the manufacture of synthetic phenol. It is reported that a process developed by Solvay engineers will be used. Last year, The Barrett Co., another Allied subsidiary, started manufacture of synthetic phenol at Frankford, Pa.

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

An "all-out" plan is now obviously necessary for much of chemical process industry if it is going to carry the increasingly heavy load being placed on it. The programs for aluminum, magnesium, ammonia, explosives, chlorine, anti-freeze, and fats and oils, all of which are described below, are but part of the problem which confronts chemical engineering managements.

Far more serious than the new and heavy load is the series of economic problems lately imposed. It is evident that draftees and National Guard members will stay in the Service far beyond the single year. Inflationary problems are increasingly difficult with wage rises and new taxes stimulating the uptrend of prices. Shortages of raw material can be expected in many lines. Shortages of every kind of metal for equipment and construction already is serious. And there is no let-up in sight.

More Light Metals

During mid-July O.P.M. completed its aluminum program with the recommendation that five companies build seven new plants to produce an additional 600 million pounds per year of this metal.

The new magnesium program was just taking shape at the beginning of August. It, however, is far from completion, as the total requirement of that ultra-light element is 400 million pounds per year, about 13 times the already stimulated 1941 output.

The placing of aluminum plants is governed by available power. Alcoa is to build three of the seven new plants and to help with engineering on two others. The total domestic capacity by mid-year 1942 is expected to be 1400 million pounds. And 200 million pounds of Canadian production will also be available each year.

The Bureau of Mines has recommended (and O.P.M. will presumably accept the proposal) the production of alumina from alunite of Utah for at least one of the new Western aluminum reduction plants. The Kalunite process recommended will, in the judgment of the Bureau, supply 120 million pounds per year of alumina for at least 10 years at a cost that is not excessive. The mineral is first roasted to drive off water, then treated with sulphuric acid and potassium sulphate. Potash alum is crystallized and then decomposed in an autoclave to form basic alum and K_2SO_4 and finally alumina. Potash and SO_2 are byproducts.

Magnesium Plans

Magnesium plans at the month-end were less definite. There had been no official announcement of any contracts, but it was known that four alkali companies were nearing completion of negotiations with R.F.C. Each is scheduled to build a magnesium plant using a process which electrolyzes magnesium chloride. The Union Potash raw material will be concentrated brines from Carlsbad. Mathieson Alkali is reported as planning to use dolomite. Brines or dolomite will supply Michigan Alkali and Diamond Alkali with their raw material.

By the first of 1942 it is hoped that the Dow output of magnesium will approach 100 million pounds per year. Permanente output depends on the success of the first unit, which was scheduled to start operation in August. If it works as hoped, the aggregate (5 unit) eventual output at Permanente will be 40 million pounds. The character of the contracts of the four alkali companies above mentioned had not been announced early in August, but it is expected that in the aggregate these four firms will produce about 120 million pounds per year of metal. There will thus remain for negotiation an output of 140 million pounds before the total required production capacity is scheduled.

Petroleum Coordination

Experienced petroleum executives are working under Petroleum Coordinator Harold L. Ickes to set up a transportation program adequate to minimize the shortage of gasoline and fuel oil in the northeastern states. Among the measures contemplated are heavier lading of tankers, use of seized foreign tankers, more rapid shuttle service, new pipe lines, accelerated rail movement, increased water shipment on the rivers and bays with craft not capable of sea-going service. In the aggregate about half of the lost tanker capacity can probably be made up without serious difficulty. But some shortage of petroleum products from Virginia to Maine seems certain. Voluntary economy in gasoline consumption during the holiday season has been disappointing. Some form of rationing is, therefore, anticipated in August.

All this petroleum problem is aggravated by threats of coal shortage or the shortage of rail facilities for coal handling into areas of increased industrial activity. The power shortage continues to be serious, especially in southeastern states. Most promising prospect of relief comes from the distress of certain manufacturing establishments who will not be able to get metal raw material and, therefore, will not need coal, oil, and power in customary quantities. This is small comfort to these establishments, but does assure some substantial measure of relief for defense industry.

The power problem of the country is being attacked by newly named Chief Power Consultant J. A. Krug, who has come to O.P.M. from T.V.A. The early hope is for 2 or 3 million kilowatts of additional capacity. But the long-time program indicates that at least 10 million kw. of additional hydroelectric and steam-electric capacity will be sought.

Forced Labor Shifts

Priority on man-power, even by commandeering men from one plant to use in another, is certain to develop before long. There has been no official announcement of this. But unofficially important government executives admit the plan.

Certain industries are likely to benefit; others are likely to be seriously hurt by this program. Any firm that has difficulty in getting labor for manufacturing desired by the government will be aided. Other manufacturers, for example those producing novelties or specialties regarded as unnecessary, may have their labor taken away from them.

Attempts to check this plan in Washington at this time generally lead to official denials that anything so drastic is contemplated. But positive evidence is available that extreme measures are being studied for application this fall. Intermediate steps will come first, but ultimately the government will see to it that those plants which it wishes to have run at full capacity are adequately staffed for as many shifts per week as are desired. Where necessary to take the needed labor away from some other manufacturer, there will not be much hesitancy in taking even that drastic action.

Chlorine Priorities

On July 28 formal priority regulations were imposed on chlorine. These gave customary preference to Army, Navy, and British needs under priorities AA to A-10 inclusive. Civilian preferences were initially ignored by this order, but are being handled by the OPACS chemical unit. Obviously interruption of chlorine supply for water treatment will not be tolerated. But equally obvious is the plan to cut severely into some of the other major civilian applications. Less bleaching of paper may be expected. And cuts in chemical synthesis with chlorine are sure unless new capacity can somehow be developed, which, at best, means considerable delay.

Government officials are giving special attention to three possible sources of supply. Diversion of chlorine from paper companies who make their own gas and caustic may be considered. There is a remote possibility that the new Chemical Warfare Service Arsenal chlorine units may be asked to supply either other military needs or even civilian purposes if the C.W.S. can spare some of its capacity for a short time. Also the magnesium program will come in for some scrutiny. Some of the new processes produce market-

able quantities of chlorine. Other processes either require all the chlorine made by electrolysis or may even require purchase of chlorine. The latter types will naturally be discouraged as compared with the former if the chlorine situation gets worse, as expected.

At the first of August there had been no final effort to determine which chlorine users will have to do without, other than some of the paper companies. Washington has already discovered that it is not safe to cut casually into chemical production. Such a cut made hastily often produces secondary effects worse than the original troubles which were being "cured".

One important shift is suggested, however, by the fact that the making of ethyl fluid for high-octane gasoline is the biggest single use of chlorine in America. Petroleum Coordinator Ickes has already suggested that all premium grades of gasoline be abandoned in the interest of economy of transport. If that is done, as seems quite possible, then the requirement of the industry for ethyl fluid will be curtailed largely. And the supplies of chlorine now going into ethyl chloride (for tetra-ethyl lead) and to release bromine from sea water may both be diverted to other synthetic chemical applications and to defense and water supply uses.

When the civilian allocation program was announced by OPACS on July 31, the following activities were assured "adequate supplies of chlorine": "Water purification, sewage treatment, sanitation, refrigerant gases for existing equipment, slime control in industrial plants, preparation of products for medicinal use, and preservation and processing of food products." The fact that other uses were not provided for in this first order merely means that OPACS was not yet ready to decide which uses would get chlorine or how much would be provided for each. It was anticipated, however, that by mid-August a number of these important matters would have been settled.

Munitions Plants

Production of lead azide and additional ammonium nitrate was added to the Army's munitions plant program during July as a number of previously announced plant sites were put under contract.

The lead azide works will be added to the duPont-operated TNT-DNT factory at Wilmington, Ill. To be built by Stone & Webster, the plant will cost $869,000. The second nitrate works (first is at Muscle Shoals, to be TVA-operated) will be built on 2800 acres of land near Baxter, Kan., at a cost estimated at $17,700,000. No operator nor contractor for this establishment had been arranged for at the end of July.

Unofficial information indicated that the two new ammonia plants to be built at Monroe, La., and Louisiana, Mo., will be operated by Commercial Solvents Corp. and Hercules Powder, respectively. Contracts were not announced as of the end of July. While individual capacities are not announced, these plants plus the expansion at Morgantown, W. Va. brings to about 1,000 tons a day the government-financed ammonia output. A 200-ton ammonium nitrate plant will be built at Baxter Springs, Kans.

A specially-formed Cities Service Defense Corp. was designated operator of the picric acid plant previously announced for Marche, Ark. Lummus Co. of New York will design and build the works at a cost of $8,554,000, with Cities Service installing machinery costing $3,553,420 to bring the total cost to $12,107,420, one-half more than originally estimated.

Expansion of earlier munitions plants put under definite contracts during the month included $9,252,911 for the Trojan Powder-operated TNT-DNT works at Sandusky, O.; $25,761,820 to add TNT-DNT-Tetryl production to the Brecon Loading Co. (Coca Cola) smokeless powder works at Childersburg, Ala.; $4,405,407 to enlarge the Atlas Powder shell loading assembly at Ravenna, O.; and $18,848,000 for the duPont ammonia works at Morgantown, W. Va.

First of the shell loading assemblies of the second plant program to reach formal contract stage was that at Texarkana, Tex. The plant will be operated by Lone Star Defense Corp., a specially-created subsidiary of B. F. Goodrich Co., which was given $33,500,000 of Army funds for sub-contracting construction work and installation of equipment.

OPACS Chemical Units

Two difficulties are interfering with plans to establish chemical units in the price control and the civilian supply divisions of OPACS. First, there is the difficulty of finding any men with actual experience in chemical market analysis who can be persuaded to take jobs in these new units. All such workers are already so busy that even these important government posts are spurned by many of the worthwhile "availables".

The second difficulty comes from the quarrel which continues between O.P.M. and OPACS. The older brother of this pair (O.P.M.) has a fairly complete chemical organization intended to serve production, purchase, and priority functions. OPACS executives are willing to cooperate with this group. But they feel that they must have certain additional staff people to give special attention to both civilian supply and price questions. There has even been uncertainty within OPACS as to whether it would have two chemical groups or one. That question had not been finally settled early in August. It may remain in an uncertain stage for some time despite the engagement of new personnel.

It has not yet been determined whether the new chemical industry committee which will advise on chemical problems at O.P.M. will serve in the same relationship to OPACS. There is some hope that it will, in order to insure real cooperation all around. The only certain thing as August opened was that the objective of the "one-stop service station" in Washington for the chemical industry had not yet been achieved.

New CWS Arsenal

Plans are well along for the new Chemical Warfare Service arsenal at Huntsville, Alabama. About $40 million is being spent on that project, which will include extensive chemical manufacturing units.

Preparation for chemical warfare now includes extensive manufacture and loading of incendiary shells. Preliminary preparation is also being made for toxic gas and other chemical warfare offense materials. Reliable reports reaching Washington from Russia and the Orient indicate that already Axis use of toxic materials has been undertaken on modest scale. This means that C.W.S. must be ready to manufacture and load ammunition of this character also.

One of the principal complications in present C.W.S. programs is occasioned by the necessity for reserving official announcements on certain subjects. It is well known that huge additional quantities of chlorine will be required by this Service, but precise estimates cannot be given to the industry as yet, not even to companies which are expected to cooperate in later manufacture. Incidentally, one of the important reasons why huge increases in magnesium requirement have been announced by the Army is that the demand for incendiary bombs of several types has been multiplied several fold as compared with the estimates of even a few months ago.

Silver Replaces Tin

Shortage of tin may force rapid industrialization of silver. This may go so far as to cause the government's reserve stock of metal to be drawn on should commercial supplies be short. Most immediate factor to this end is the proposal from National Academy of Sciences to O.P.M. that silver be substituted extensively for tin in solder.

The Academy report assumes that next year it may be necessary to eliminate three-quarters of the tin ordinarily used by American industry either through replacement or by some "do-without" plan. The remaining quarter of the normal supply could be prepared by U.S. smelting of Bolivian ore and in careful use of secondary metal. Of course, the present stockpile would go largely direct to defense uses, or would be allocated to industry for manufacture under defense orders.

Other tin economies recommended include extensive substitution of glass

(Please turn to page 122)

COLLEGE DEFENSE TRAINING ENTERS NEW FIELDS

Widening of the sphere of activity of the Engineering Defense Training program is emphasized by appointment by U. S. Commissioner of Education, John W. Studebaker of three additional members to the committee of prominent engineering educators advising staff members of the U. S. Office of Education, on broad policies relating to the training of defense workers by the nation's colleges and universities.

To conform with the broadened scope of this program its title is being changed from "Engineering Defense Training" to "Engineering, Science, and Management Defense Training."

New Advisory Committee members are Homer L. Dodge, dean of the Graduate School, University of Oklahoma, Clare E. Griffin, dean of the School of Business Administration, University of Michigan, and N. W. Rakestraw, professor of chemistry, Brown University. Dr. Dodge will advise on matters relating to the training of physicists, Dr. Griffin on the training of production supervisors, and Dr. Rakestraw on the training of chemists.

Other members of the Advisory Committee who have served since last fall are Andrey A. Potter, dean of engineering, Purdue University (chairman); F. L. Bishop, secretary, Society for the Promotion of Engineering Education; R. E. Doherty, president, Carnegie Institute of Technology; Gibb Gilchrist, dean of engineering, Texas A. and M.; H. P. Hammond, dean of engineering, Pennsylvania State College; W. O. Hotchkiss, president, Rensselaer Polytechnic Institute; R. S. McBride, consulting engineer, Washington, D. C.; Thorndike Saville, dean of engineering, New York University; C. C. Williams, president, Lehigh University; B. M. Woods, professor of mechanical engineering, University of California, and Allen W. Horton Jr., U. S. Office of Education.

INJURY RATES IN CHEMICAL PLANTS ROSE LAST YEAR

The National Safety Council in reporting on accident rates in the chemical industry in 1940 places frequency at 8.65 reportable injuries per million hours worked; severity at 1.33 days disability per thousand hours worked. The frequency rate is two-thirds the average for all industries. The severity rate is only slightly below the general average of 1.44.

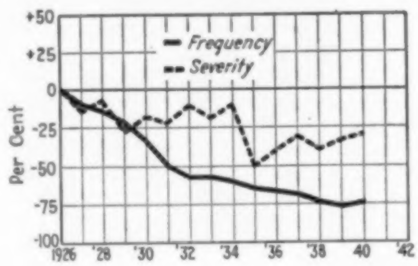
The 1940 injury rates for chemical plants averaged 10 percent higher in frequency and 6 percent higher in severity than for 1939. The changes in both rates compare unfavorably with no change in frequency and a reduction of 1 percent in average severity for all industries.

Chemical plants have had average reductions of 74 percent in frequency and 29 percent in severity since 1926. The frequency reduction is larger than the average of 69 percent for all industries but improvement in severity is only three-fifths the general reduction of 50 percent.

Frequency rates were lowest in plants manufacturing plastics, alcohol and solvents, and industrial gases, averaging less than three. Severity rates were lowest in alcohol and solvents manufacturing, industrial gases, and laboratories, averaging 0.13 and lower.

The Old Hickory, Tenn., plant of the E. I. duPont de Nemours & Co., holds

Percentage Changes in Accident Rates Chemical Industry



the best all-time no-injury record in the industry.

The 1940 experience of chemical plants was generally unfavorable in comparison with results in most industries. While frequency rates averaged 31 percent below the all-industries rate of 12.52 and chemical plants ranked 9th among 30 major industries, this was a drop from 7th place ranking in the preceding year. The industries rank in severity was 18th compared with 17th for 1939.

JUNIOR CHEMICAL ENGINEERS ELECT OFFICERS

The Junior Chemical Engineers of New York, organized four years ago, have elected officers for the ensuing year as follows: Francis B. White, Foster-Wheeler Corp., president Howard Ten Broeck, Socony Vacuum Oil Co., vice-president; John R. Callaham, *Chemical & Metallurgical Engineering*, secretary-treasurer; and Herbert Quina, American Agricultural Chemical Co., assistant secretary-treasurer. Heading the various committees are: program—William H. Healey, General Chemical Co.; membership—Robert L. Zapp, Columbia Carbon Co.; publicity—Albert K. Ackoff, Westvaco Chlorine Products Co.; banquet—Richard de Wolfe, M. W. Kellogg Co.

EMILE PFIZER MADE BEQUESTS TO OLD EMPLOYEES

The will of the late Emile Pfizer, president of Charles Pfizer & Co., who died in New York on July 19, was admitted to probate at Somerville, N. J., on July 31 and revealed that it included bequests totaling $237,000 to employees who had seen years of service with the Pfizer company. The bequests ranged from $250 to $4,000. The will disposed of an estate of $3,000,000 and ten hospitals and institutions in the metropolitan area will eventually share in the residuary estate.

PRIORITIES DIVISION HOLDS MEETINGS WITH CONSUMERS

E. R. Stettinius, Jr., Director of Priorities, announced last month that the Priorities Division will hold a series of training courses during the next several months for business and industrial priorities specialists. These meetings will be open to officials appointed by their companies or trade groups. A number of plants recently have appointed members of their staffs to specialize on priorities problems.

More than 100 priorities specialists from the steel industry attended the first training clinic, heard members of the Priorities Division staff explain procedure, and took part in round table discussions on problems which have arisen in their field. The second course was for trade association executives.

Under the present plant future meetings will be held only for homogeneous groups from one industry so that the discussions may be properly concentrated on problems within that industrial area.

COURSE IN CHEMICAL ANALYSIS AT BROOKLYN POLY

An intensive course in applied chemical analysis, designed to give competency in laboratory practice connected with national defense, started Aug. 4, at the Polytechnic Institute of Brooklyn, Professor Raymond E. Kirk, institutional representative for engineering defense training courses has announced. Sponsored by the U. S. Office of Education, the course will be given in both day and evening classes, without cost, to qualified applicants who have successfully completed at least two years of college chemistry, including one term of quantitative chemical analysis.

TITANIUM PIGMENT CO. WILL BUILD NEW PLANT

The Titanium Pigment Co., subsidiary of the National Lead Co., has acquired a large tract of land at Tehawus, N. Y. which will be used as a site for a new plant to include production units, storage and distributing buildings and a housing development for its employees. It is reported that the total cost of the project will be around $5,000,000 with the Wigton-Abbott Corp., New York as the contracting builders.

CONFERENCE ON DISTRIBUTION IN BOSTON

The Thirteenth Boston Conference on Distribution is scheduled at the Hotel Statler, Boston, on Oct. 6-7. This conference is styled a national forum for problems of distribution and is sponsored by the Retail Trade Board, Boston Chamber of Commerce, in cooperation with Harvard University Graduate School of Business Administration, Boston University College of Business Administration, and Massachusetts Institute of Technology.

GERMANY ESTABLISHES INTERNATIONAL CARTELS AS PART OF NEW EUROPEAN ECONOMY

Special Correspondence

International cartels, some new and some reorganized, are playing a large part in German plans for building a Continental European economic bloc. Recent renewal of the German iron and steel cartel is significant because it includes not only German plants but also plants in Luxembourg, Lorraine, Eastern Upper Silesia, and Austria, most of which had been members of the International Steel Cartel which broke up at the outbreak of the war. Leading German steel interests have pooled resources and are operating Lorraine iron ore mines under direction of the Herman Goering concern with production being carried out as sub-contracts from German firms or for the "account of the Reich." A woodpulp cartel to replace the sulphite cartel which collapsed at the outbreak of the war was organized toward the end of 1940 and includes the chief pulp producers and exporters of Europe, chiefly the Scandinavian countries, Slovakia and Germany. Similar cartelization has taken place in the fields of cement, glassware, cellulose, rayon, staple fiber, woodconstruction, and even zippers and will probably be expanded to coal, potash, synthetic nitrates, etc.

International cartels, now following more political than private objectives, originated in the 1870's, and were formed chiefly in Central Europe, where they tended to alleviate harmful effects upon economic interests caused by the political disunity of the area. In 1914, of 114 cartels, the two largest groups were in the chemical field with 19, and coal, ores and metal, which were represented by 22 separate cartels. Germany has generally fostered the cartel idea in Europe. By 1928, 12 new chemical cartels had been formed, the most notable being in the potash field, where French and German competition required some regulation. Despite animosities the various cartels helped to overcome economic dislocations. In the present war it has been easier for the chemical than for other German industries to coordinate activities in Nazi-occupied territories, especially since large German corporations, as I. G. Farben, have long been cartel members as well as important stockholders themselves in many of the central and eastern European and Scandinavian plants concerned.

That the large corporations are not free of restrictions, however, is indicated by increasing governmental control as well as the growing tax burden they are carrying. On June 21 of this year a government decree prohibited any increase in corporation dividends for the duration of the war, unless the dividends have been less than 6 percent, in which case they can be raised to that level, which is to be considered as the "norm" for returns in the future. Dividends of 6 to 7 percent will be taxed one-half percent of the nominal capital they represent, and those from 7 to 8 percent, two percent, while for dividends above 8 percent, the tax will admittedly be prohibitive. This is being done to raise revenue, to direct capital to desired channels, as well as to force "undercapitalized" concerns to restore greater accuracy in balance sheets for general tax purposes.

The Polish chemical industry has now been well incorporated into the Reich machine, although much of its output especially of fertilizers, is primarily for local consumption. Former Polish state-owned factories have been incorporated into a specially-administered "Werke des General Gouvernements A. G." with the Herman Goering concern taking over direction especially of the heavy industries. This mammoth state concern has interests that now include mining, smelting, manufacturing, and shipping branches. The largest chemical factory in Poland is the Moscice plant near Tarnow in Eastern Upper Silesia, which processes salt, coal, and air, and produces nitrate fertilizers, ammonia, and nitric acid as well as sodium hydroxide and chlorine. Arrangements are being made to include phosphate fertilizers in the production program of this plant, which was completed by the Germans in the World War and was taken over by the Polish government when the area was ceded to Poland after the Upper Silesian plebiscite in 1921. Nearby is a second large enterprise, the Pionski powder factory near Radom, which formerly produced powder and explosives. Also close to Upper Silesia and the former German boundary are two plants at Kielce and Rudniki near Czestochowa, producing fuming and concentrated sulphuric acid and tanning materials. Another large plant, turning out cellulose as raw material for the rayon industry is located at Niedemice, utilizing local wood and pyrites. The Germans have taken over a fairly well developed pharmaceutical industry, which includes 45 plants in the General Government, of which 32 are in Warsaw and the remainder in Cracow, Czestochowa, Kielce, and Radom.

Polish laborers are working in increasing numbers in the Reich to relieve the acute labor shortage caused by the large numbers of German men bearing arms. Besides 1.3 million foreign agricultural workers, including war prisoners, there are now approximately 1 million foreign skilled laborers voluntarily working in the Reich. The total was raised from 670,000 at the beginning of the year, and has recently reached the million mark. Of these, approximately

300,000 are Italians, 218,000 Scandinavians, French, Belgians and Hollanders; and 46,000 Slovaks. About 400,000 of them are employed in the building trades and the remainder in iron and metal industries and mining. They are housed in large barracks in the suburbs of large cities, with 100 dormitories already built or being built around the city of Berlin alone. Other industrial centers where foreign workers are concentrated,—whenever possible in separate dormitories for each nationality,—are in the Ruhr, in Braunschweig, in the Austrian mining and smelting plants around Linz, and in the central German lignite mining area.

Most of the workers are under contract for one year's labor, although they are allowed vacations twice a year to return to visit their families, they are paid the same wages as German workers in the same jobs, generally do not have to pay rent in the dormitories, and are permitted to send a large part of their wages home.

To make more workers available for industries considered essential for the conduct of the war, a further reduction of consumer-goods production has been carried out in the past few months. Capacity of occupied territories is being utilized as much as possible. In this way the Reich has been able to attain a fair degree of self-sufficiency and at the same time is trying to lay the foundation for a post-war continental economy—all of which, of course, presupposes a Nazi victory. Nethertheless, there are still a number of products that have not been heretofore produced in western Europe or are unproduceable there. Chief among these is oil. The Reich's chances of diverting Soviet Russian oil production for her own use depends entirely on the outcome of the present Soviet-German clash. Mining machinery is another item on which continental Europe in the past depended largely on imports. Then there are such specialized raw materials as vegetable oils, tropical woods, coffee, cocoa, tea, cotton, wool, tin, and rubber which are not available in Europe. Synthetic rubber production, however, is definitely beyond the experimental stage. Even before the outbreak of the war, synthetic rubber, and that included 13 different patented types of Buna, supplied over 40 percent of German's consumption; in the meantime the ratio has of necessity become much higher. In addition to synthetic rubber, regenerated and natural rubber, the Reich apparently has enough supplies of cotton, sulphur, carbon black, and zinc oxide necessary for tire production at least.

One item that is pinched in spite of apparent abundance of deposits and producing capacity is coal and coke. The "Deutscher Volkswirt" admits that the supply of industrial coke is far below current needs and that great difficulties are being experienced in supplying Sweden and other countries now dependent upon the Reich.

STABILITY OF PRICES FOR CHEMICALS THREATENED BY TRANSACTIONS IN THE RESALE MARKET

The Manufacturing Chemists' Association has recently made a graphic presentation of the course of chemical prices from 1913 through May of this year. The presentation is based on U. S. Bureau of Labor indexes and shows that the trend of the chemical price index has been consistently downward since the peak rise in 1916. The most significant feature of the compilation is the marked contrast shown in the price movement throughout the first World-War period and that reported from the time hostilities broke out in Europe in 1939 up to the present.

In the first war period, this country was more dependent upon imported chemicals than it was in 1939 and the curtailment—and even elimination—of shipments from abroad threw the market wide open to speculative influences which soon spread to the distribution of domestic chemicals. In 1939 we had a well rounded chemical industry, the greater part of distribution was effected by direct contracts between consumers and producers or accredited representatives of producers. As a result, prices from 1939 to date have been largely stabilized, speculative trading has been held to a minimum, and consumer-needs have been filled in an orderly way.

For a long time a sellers market has existed and based purely on the law of supply and demand, with competitive forces inoperative, it would have been possible to mark prices up sharply without affecting the volume of trading. Yet producers chose to maintain a stable market and to further protect their customers, refused to accept orders from sources which had no consumer standing. It is true that, in recent months the price curve has turned upward but revisions have been far from general and have been so limited in scope as to do little more than absorb all or a part of increased manufacturing costs.

The orderly price movement which has held true in the sale of the great bulk of chemicals has not been observed in the spot market where limited amounts of the scarcer chemicals have changed hands at prices somewhat reminiscent of the exorbitant levels reached in 1916. As raw materials become diverted more and more to direct defense projects, the supply for regular industrial use is cut down and greater incentive given to bootleg stocks. Hence this aggravating situation may become worse unless restrictive measures are taken.

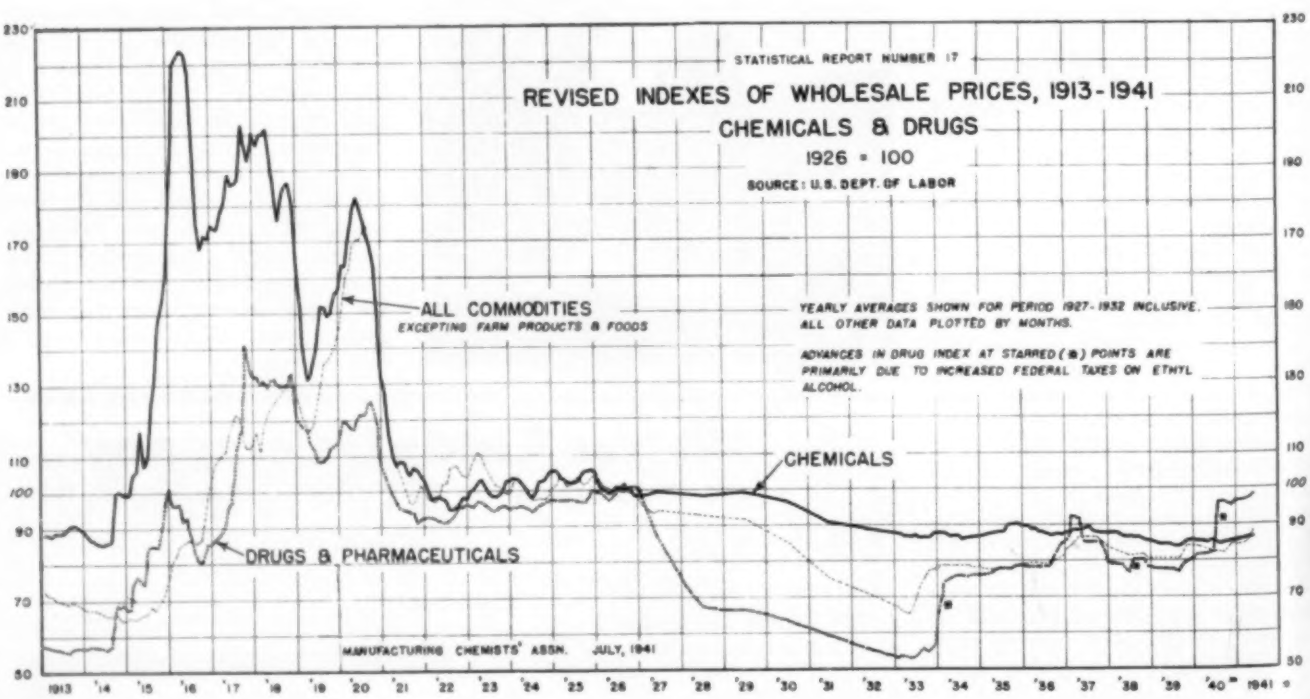
Certain consumers of chemicals are believed to be contributors to the supplies which have figured in resale transactions. These concerns place orders for chemicals supposedly for their own use but place part of the goods in the hands of resellers who push up prices as high as the trade will stand. This not only creates a distorted impression regarding sales prices but also takes advantage of small users who do not go direct to producers for their supplies. This practice has continued long enough for the industry as a whole to take cognizance but if producers were to join forces in an effort to identify the nominal customers who are acting as second-hand sources of supply, they, in turn, might be open to charges of illegal agreements in restraint of trade.

There are two corrections that can be worked, and both are needed. The purchasers of chemicals who have been patronizing the bootlegging factors should stop their present buying practice. It is not necessary for them to pay high prices of this sort. They are damaging their own cause when they trade in this fashion. They should go to primary producers, explain their needs, and be cared for.

In the second place, those acquainted with this practice should report the facts. This is not tattling. It is an urgently needed public service. The chemical division of the civilian allocation unit in OPACS is organized to handle such cases. It is not a policeman. But it does have the job of seeing to it that civilian users of chemicals are supplied according to their need. This gives authority to withhold from those who do not have need, as well as the responsibility for supplying those who do. Incidentally, therefore, there is a basis for that needed official cooperation from Washington which can help to stop this highly undesirable practice.

Whenever and wherever unreasonably high spot prices for special chemicals are encountered, the facts should be determined. If this is the result of bootlegging, which may often be the case, then official action should be sought. A few sharp disciplinary actions from Washington will do more to clean up this unfortunate situation than anything else which has happened thus far. Everyone will gain from such a clean-up except those who are profiteering by bootlegging.

The comparatively small advance in the average price level for chemicals in the last two years is all the more commendable in view of the numerous factors favoring higher costs of production. It is noted that several price adjustments were made in the last month.



WASHINGTON NEWS

(Continued from page 115)

containers for beer and acid or corrosive foods which may not readily be canned in thin-tin coated metal. Extensive replacement of dipped tin plate is contemplated by the use of more thin electroloytic tin plate. Also, black (untinned) steel or lacquered steel should be extended, according to the Committee, beyond the field of paints, lubricating oils, and similar materials which have already abandoned heavy tin-coated cans.

Chemical Miscellany

Refractory Shortages—Both chromite and magnesite refractories are increasingly difficult to secure as imports are unavailable. To reduce the drain on the chromium supply, the use of chromite in refractories is now limited to defense orders or for urgent maintenance and repair work. Close inventory control is required.

Priority Training—O.P.M. Priority Division has been sending businessmen to school. Recognizing the difficulty of meeting complicated technical rules, Director Stettinius has provided clinics at which representatives of closely related industry can be schooled to facilitate cooperation with the government and to speed up the getting of proper priority allowances for those who deserve them.

Tariff Cuts—A further trade agreement with Cuba has been undertaken and the State Department announces that certain mineral raw materials, low-grade sugars and molasses, certain tobaccos, and a few foods may have present duty rates lowered. Industry representatives are also struggling with Congressmen in the hope that they can prevent the granting of authority to waive duties on commodities certified by any government agency as required for defense. Industry spokesmen urge that the collection of duties is merely a bookkeeping transaction and that the government does not gain anything by repeal. They feel that commodities brought in duty-free during the emergency may be so conditioned afterward as there is no time limit in the original bill. It is argued that the measure as proposed would transfer tariff-making power from Congress to any government agency concerned with defense.

Trade Blitzkreig—Uncle Sam is fully embarked on a program of economic warfare. This has both positive and negative aspects. The Hemisphere program is being increased to provide more buying power through Latin America, by taking increased mineral supplies needed in the United States. Of benefit to chemical process industries among recent arrangements are increased supplies of lead from Mexico, Canada, and Peru, and an increased zinc supply from the Argentine. All of the Brazilian production of strategic materials is now to come to the United

States. Of the opposite effect is the requirement that American enterprise stop doing business with hundreds of firms which are on the official black list. Of course, American opportunity to have tremendous economic influence is seriously limited by the shortage of shipping space. If Uncle Sam had big cargo fleets at his command, he could maneuver many world situations through economic influence that would respond to such controls even more promptly than to military action.

Research and O.S.R.D.—The President established the Office of Scientific Research and Development as a unit in the Executive Office of the President. Dr. Vannevar Bush, president of Carnegie Institution of Washington, is the principal executive officer. President James B. Conant of Harvard University succeeds Dr. Bush as chairman of Nation Defense Research committee, which now becomes the main project and planning unit of O.S.R.D. Thus, greater influence and higher official status is accorded to the same executives who have been leading the defense research activities for some time.

Cotton Linters—Civilian allocation of cotton linters was announced August 1. Restriction was placed on the seed crushing plants as to the length and character of various linter cuts. Preservation of supplies of high grade linters for explosives making is the objective. Some conversion of staple cotton into short lengths for use in plastics and for explosives is being studied by the Department of Agriculture and by other government and industry groups.

Economic Defense—To give maximum influence to the new board of economic warfare, Vice President Wallace was named as chairman of this "Economic Defense Board". Controlled import and export programs are to be developed, supplementing the Hemisphere projects already under way and extending this type of commodity controls to a world-wide program.

More Rail Movement—Washington is forcing rail movement of many goods that have previously been handled by coastal shipping. New lower carload rates on crude sulfur and trainload rates of certain commodities like petroleum and phosphate rock are already in force or planned for the immediate future. The main obstacle is that even rail facilities are becoming short. Hence, active steps are being taken to speed up unloading and rehandling of freight cars. At the first of August it looks as though freight car priorities will have to be established by early Fall.

Wood Chemical Institute Will Move To Bradford

Wood Chemical Institute, Inc. will move on Sept. 1, from the Albee Building, Washington, D. C., to Terminal Building, Bradford, Pa. J. A. McCormack has been elected secretary-treasurer, to succeed Dr. M. H. Haertel, resigned, who will maintain his address at the Albee Building, Washington.

PERSONALITIES

J. Clarke Cassidy

Jules Bebie

✦ J. CLARKE CASSIDY, for many years works manager of Niagara Alkali Co., and Electro Bleaching Gas Co., has been elected president of the former, which by a recent union, now includes the Electro Bleaching Gas Co. At the same time Mr. E. D. Kingsley was elected chairman of the board while Mr. S. W. Jacobs and Mr. S. J. White, continue as vice presidents.

✦ FREDERICK H. MCDONALD has resigned as industrial and development engineer for the South Carolina Public Service (Santee-Cooper) Authority to resume private practice as a consulting engineer in the fields of industrial plant location, community development, electric power rates and the utilization of natural resources. His offices will be in Charleston, S. C.

✦ T. R. RHEA has been appointed engineer of the chemical section, a new section in General Electric's Industrial Engineering Department. The chemical section has been established to carry on activities which heretofore have been a part of the work of the mining section of the G-E Industrial Engineering Department. Mr. Rhea was born in Bonham, Tex. He enlisted in the U. S. Army in 1917 and spent about six months at Texas A. & M. as part of his training for service overseas, and then went to France with the A.E.F. Later he attended Tulane University and Massachusetts Institute of Technology.

✦ BERTRAND A. LANDRY has joined the staff of the Battelle Memorial Institute, where he is engaged in the research and development work in the division of fuels research. A graduate of M.I.T. and Carnegie Institute of Technology, Mr. Laundry was for 18 years associated with the U. S. Bureau of Mines prior to joining Battele.

✦ JULES BEBIE has accepted an invitation to head the chemical engineering department at Washington University, St. Louis. Dr. Bebie was born at Zurich, Switzerland, and was educated in that country. He was connected with the Chemical Works, Brugg, Switzerland, before coming to this country. In 1905, he joined Monsanto Chemical Co. and remained with that organization as research director until 1930 when he left to do consulting work.

✦ J. M. BOWLBY has been elected president of Eagle-Picher Lead Co., Cincinnati, to succeed Joseph Hummel, Jr., who has asked to be relieved of his active duties and was elected chairman of the board. The new president is a native of Richfield, Ill.

✦ RALPH L. SHRINER, professor of organic chemistry at the University of Illinois, has been appointed chairman of the Indiana University Chemistry Department. Dr. Shriner will succeed Dr. H. T. Briscoe, who will devote his full time to the duties of dean of faculties at the university and director of student guidance. Dr. Shriner received the B.S. degree from the Washington University at St. Louis, Mo. in 1921 and served as instructor of chemistry there the following year. In 1923 he received the M.S. degree from the University of Illinois and in 1925 the Ph.D. degree.

✦ FRANCIS M. SADLER has accepted the position of chemical engineer with H. A. Kuljian & Co., consulting engineers, Philadelphia. He will be employed primarily in the design of chemical plants and process equipment.

✦ G. G. REED, a new member of the Dicalite Co. and a graduate of the University of Missouri, is now head of the St. Louis office of the company. He had been previously associated with Sherwin-Williams Co. and International Filter Co.

✦ GEORGE E. SHAW has been appointed manager of the southern district by the Dicalite Co., with headquarters at New Orleans. Previously to joining the Dicalite organization, he was for some years special filtration engineer and representative of the Oliver-United Co.

✦ ARTHUR S. ADAMS has been appointed assistant dean of college of engineering at Cornell University. Dr. Adams came to Cornell a year ago from the Colorado School of Mines where he was assistant to the president, as one of a group of three assistants to Dean Hollister.

✦ LAWRENCE E. WELCH, a graduate in mechanical engineering from M.I.T., has joined Bakelite Corp. in its research and development laboratories at Bloomfield, N. J. Another addition to the research staff is Dr. Alford G. Farnham, who received a B.S. in chemistry at Monmouth College in 1937 and majored in organic chemistry at the State University of Iowa, receiving the M.S. degree in 1939 and Ph.D. degree in June of this year.

✦ HOWARD J. TAIT has been appointed works manager at the Newark, Ohio, factory of the Holophane Co.

✦ PAUL T. GRAFF has joined the Foxboro Co. as sales engineer, specializing in the promotion of the company's control instrumentation. He will be located at the company's office at Foxboro, Mass.

✦ R. K. DAVIES, vice president of the Standard Oil Co. of California, has been appointed deputy oil coordinator by the federal government, to serve under Secretary of the Interior Ickes. The company has granted Mr. Davies leave of absence for the purpose.

✦ EDWARD MACK has been appointed chairman of the chemistry department of Ohio State University.

✦ K. D. SMITH, technical superintendent of the tire division of the B. F. Goodrich Co., for the past nine years, has been named assistant to T. G. Graham, vice president in charge of factory operations. Mr. Smith will represent his office on special technical assignments.

✦ A. W. PHILLIPS has been appointed general superintendent of the tire

division of B. F. Goodrich Co. Mr. Phillips, formerly manager of the company's plant at Oaks, Pa., started in the rubber industry at the age of 16, and at 18 he was an assistant foreman. Joining the B. F. Goodrich Co. in 1928 he held important executive positions in the company's Akron and Los Angeles plants before his promotion to general manager of the Oaks Division in 1938.

Harold Gray

✦ HAROLD GRAY, has been appointed to the post of technical superintendent of the tire division of the B. F. Goodrich Co. Manager of tire and tube development since 1932, Mr. Gray is a graduate of the University of Indiana.

✦ JESSIE E. MINOR, consultant in the paper industry, is now in charge of the laboratory of the Hurlbut Paper Co., at South Lee, Mass. Dr. Minor will devote all her time to the Hurlbut Paper Co., having given up her office in Springfield and moved her complete laboratory equipment to the mill at South Lee. She is a graduate of Drury College in Springfield, Mo. and holds a Ph.D. degree in chemistry from Bryn Mawr College.

✦ ROBERT M. MACINTOSH has been appointed head of the division of analytical chemistry at Battelle Memorial Institute, Columbus, Ohio.

✦ JULIUS F. KAPLAN, a 1941 Ph.D. graduate of the University of Illinois, has joined the staff of the Edwal Laboratories, Inc., Chicago, Ill., where he will have charge of the manufacture of special chemicals. Dr. Kaplan is a native of Chicago and attended local public schools before entering the University of Illinois.

✦ CALVIN H. MOHR, who received his degree from the chemical engineering department of Massachusetts Institute of Technology in 1933, has joined the staff of the Ringwood Chemical Corp., Ringwood, Ill., manufacturers of organic chemicals and associated with

the Edwal Laboratories. Mr. Mohr worked previously as chemical engineer for the du Pont Rayon Co., R. & H. Chemicals Division of the du Pont Company, and the Tubize-Chatillon Corp.

✦ AUBEY J. GRINDLE has returned to the Pulverizer Department of the Whiting Corporation, Harvey, Ill. For the past several years he has been engaged in consulting practice.

✦ JOHN M. WHELAN, JR., who received his training in chemistry and an M.E. degree at Stevens Institute of Technology has joined the Bakelite Corp.

✦ FRANK REVELL has joined the staff of sales engineers of Foxboro Co., Foxboro, Mass. He will be attached to the company's New York Office. For the past five years Mr. Revell has been employed in the Instrument Maintenance Department of the Calco Chemical Co.

✦ ERWIN L. GEHRKE has been added to the staff of sales engineers attached to the New York branch of the Foxboro Co. Mr. Gehrke is a graduate of Harvard University and the New York University engineering courses.

✦ CAMPBELL R. MCCULLOUGH has been transferred from the research staff of the Phosphate Division, Monsanto Chemical Co. to the Central Research Department of the company.

Carl Iddings

✦ CARL IDDINGS has been appointed vice president and general manager of the Prescott Paint Co. Dr. Iddings until recently has been vice president and general manager of the Muralo Co. of Staten Island, N. Y., with which company he has been associated for the past nine years. After graduating from the University of California with degrees of B.S. and Ph.D. in chemistry, he was connected with the Union Oil Co. of California, in charge of a division of the research department having to do with cracking operations. Dr. Iddings also spent some time with the

U. S. Department of Agriculture in the Fixed Nitrogen Laboratories, and before joining the Muralo Co. had been in charge of the research laboratory of the General Chemical Co.

▶ Charles Kalb is now employed as a chemical engineer with du Pont at the finishes plant, Toledo, Ohio.

▶ Robert E. Vivian is now dean of the College of Engineering at University of Southern California. Professor Vivian has served as acting dean for the past year.

▶ David E. Pearsall has been made director of the recently organized research laboratories at Avon, Conn., of the Ensign-Bickford Co.

▶ Howard F. Shenton is now connected with Sheppard T. Powell, chemical engineering consultant of Baltimore.

OBITUARY

Evald Anderson

✦ Evald Anderson, technical director of Western Precipitation Corp., died July 19, ending a career of unusual accomplishment. On graduating from the University of California in 1913, he joined Western Precipitation Co. with which he spent his entire business career. He soon was made technical director of the company, which position he occupied until his death. His creative effort led him into many fields and wherever he was active he established lasting friendship and gained the recognition and respect of his technical associates. In February, 1940, he was presented with a Modern Pioneer's Award, prompted by the National Association of Manufacturers in recognition of his outstanding accomplishments.

Mr. Anderson was born in Sweden December 3, 1883. He obtained patents on many inventions relative to electrical precipitation, mechanical dust collectors, byproduct potash production and was the author of many articles on electrical precipitation and kindred subjects.

✦ **Owen Louis Shinn**, professor of applied chemistry at the University of Pennsylvania, and a member of the school faculty for nearly half a century, died June 10. He was 69 years of age. Dr. Shinn, who had been on leave of absence for a year, because of ill health, was graduated from the university and became an instructor in chemistry there in 1893. In 1905 he was promoted to a professorship.

✦ **William Hall Campbell**, president of Garrigues, Stewart & Davies, Inc., died July 12 at Plainfield, N. J. In the Fall of 1897 he joined the Garrigues Chemical Co. and when Mr. Garrigues died about ten years later, Mr. Campbell bought out the business. In 1927 he changed the corporate name of the firm to Garrigues, Stewart & Davies. He remained president until his death.

✦ **Robert C. Farrington**, chief engineer of the Austin Co. since 1919, died at St. Joseph's Hospital, Fort Worth, Tex., July 15, following a heart attack suffered about two weeks ago. He was 59 years of age.

✦ **Theodore W. Sill**, assistant manager of sales of the Organic Chemicals Division, Monsanto Chemical Co., died July 17, at Barnes Hospital, St. Louis, after an illness of several months. He was 52 years old. Mr. Sill was born in Rochester, N. Y. and is a graduate of Princeton University. He also attended Pratt Institute and New York University. He began his business career as manager of Bull's Ferry Chemical Co. and served later with E. C. Klipstein & Sons Co., Westvaco Chlorine Products Co., Forhan Co. and Osborn Development Co.

✦ **Stephen B. Andrews**, comptroller of Goulds Pumps, Inc., Seneca Falls, N. Y. died July 19.

✦ **H. F. Sturges**, traffic manager of Manhattan Rubber Mfg. Div. of Raybestos-Manhattan, Inc., Passaic, N. J., died June 27 after a short illness. Mr. Sturges had been associated with Manhattan for 33 years.

✦ **Clarence H. Kennedy**, vice-president in charge of sales of Kennedy Valve Mfg. Co., Elmira, N. Y., died July 21 at the St. Joseph Hospital, Elmira.

✦ **Meredith N. Bailey** died July 24 at his home in Royersford, Pa. He was 61 years of age. Mr. Bailey had been active in the gas industry during the past 30 years.

✦ **Ralph S. Hafer** was killed in an automobile accident May 27. He was on his way to Texas at the time of the accident. Mr. Hafer was a graduate of the University of Pittsburgh's chemical engineering department in the year 1940.

NEWS OF PRODUCTS AND MATERIALS

EMULSIFIERS AND EMOLLIENTS

Two emulsifiers and emollients for cosmetic preparations have been announced by Atlas Powder Co., Wilmington, Del. Arlacel A and Arlacel B are monooleate esters of anhydrohexitols. Arlacel A is a versatile emulsifier for the production of widely applicable cosmetic bases. (1) Produces water-in-oil type bases, creams and lotions stable in the presence of acidic electrolytes such as aluminum sulphate and chloride. (2) Gives very high water absorption when used as an emulsifier for petrolatum. For example, 2,400–2,500 parts of water can be added and emulsified with 100 parts of a base consisting of 10 per cent Arlacel A in petrolatum (standard water absorption test). (3) Produces very finely dispersed emulsions of inviting appearance, excellent spreading qualities and smooth, velvety texture. (4) Is in itself an emollient.

Arlacel B is a general emulsifier of wide application. Its use gives: (1) Water-in-oil type emulsions, the type ordinarily made with lanolin and lanolin derivatives. (2) As an assistant emulsifier for oil-in-water type creams, sufficient stability to permit hot pouring. (3) Very high water absorption 100 parts of a base consisting of 10 per cent Arlacel B in petrolatum will absorb and emulsify 2500–2600 parts of water. (4) Fine particle size emulsions and insurance against bleeding and sweating of cosmetic creams. (5) Products easily perfumed.

AMMONIUM THIOCYANATE

Large scale production of ammonium thiocyanate is now under way at the Everette, Mass., plant of the Eastern Gas & Fuel Associates, it has been announced by Fred Denig, vice president of Koppers Co. in charge of the research department. The plant has an unusually large annual capacity and is built to produce both crystals and 30 percent liquor. The grade of crystals now under production has a purity in excess of 95 percent.

ENAMEL FRITS

Porcelain enamel frits for fitting a wide range of products have been announced by the Porcelain Enamel & Manufacturing Co., Baltimore, Md. Among the products are: Superpake, especially developed for a one-coat finish on refrigerators, washing machines and other volume production products. Neopake, an antimony-free finish having the same high-production qualities and uses as Superpake. Pyroflex, a one-coat one-fire, colored finish, firing at 1,400 deg. F. to 1,450 deg. F. Pyronamel, a one-coat, one fire, acid-resisting finish applied direct to metal. Architex, a superior finish for the architectural and building fields. Sanifrit, a complete series of finishes developed particularly for use in the formed metal plumbing ware field. Synamels, a complete series of easier-working, durable sign finishes having the flexibility necessary for the production of a wide range of colors and effects. Satynite, a new porcelain finish for hot water tanks which eliminates corrosion and lengthens their life. Widely used in areas where adverse water conditions prevail.

PROTECTIVE COATING

Properties of Flexalyn, dietheylene glycol diabietate, particularly its miscibility with water soluble colloids such as starch, casein and glue, suggest its value in protective coatings, casein paints, wallboard coatings, lacquers, adhesives, plastics, paper coatings, rug back-sizing mixes, for modifying waxes, softening rubber, transparentizing paper, as a binder in priming coated cloth, and in modifying thermosetting plastics. This is a product of Hercules Powder Co., Wilmington, Del. It is a pale-colored, extremely tacky, translucent, semi-solid resin resulting from the esterification of the isomeric acids in rosin with diethylene glycol. It is actually the diethylene glycol ester of a mixture of isomers of which abietic acid is the typical constituent. It is completely soluble in almost all solvents including mineral and vegetable oils, except those of the alcohol type; and it is compatible with a wide variety of resins, waxes, gums, asphalts, pitches; is com-

Physical Properties

Commercial Specifications of Solid Flexalyn

Acid number	5–10
Melting point deg. C.	45–50
Color (lovibond 50 mm. tube)	24–40 Amber
Density at 25 deg. C.	1.071–1.074*
Refractive Index at 20 deg. C	1.5361–1.5363
Saponification no	30-40*
Per cent unesterified free hydroxyl	1.0–1.5*
Per cent free glycol	00–.075

*Exact Analysis of a Typical Sample

Density	1.073
Refractive index	1.5362
Saponification no	34.5
Per cent unesterified free hydroxyl (corrected for the carboxyllic hydroxyl content)	1.1
Per cent free glycol	.03

Specifications of Flexalyn Solution (80% in Xylene)

Acid number	4–8
Color (Lovibond 50 mm. tube)	50–75 Amber
Specific gravity 25 deg. C.	1.013
Flash point (Tagliabue open cup)	95–115 deg. C
Viscosity in cp at 25 deg. C.	271
Per cent solids	70.5–80.5
Lb. per gal	9.4

Typical Constants of Flexalyn Emulsion

Particle size	85–100% under 5 microns
pH	6.7–7.5
Per cent solids	32–34

patible with water-insoluble film-formers and miscible with water soluble film-formers. Flexalyn is a resin with a high refractive index. It is sticky and persistently adhesive. It is neutral—it is non-hygroscopic and water insensitive. It is compatible with most film-formers — with nitrocellulose, ethyl cellulose, polycyclo rubber, chlorinated rubber, rubber itself, latex, shellac.

AIR DRY FINISH

One of the new air dry finishes is Amron recently announced by The United States Stoneware Co. It is a synthetic resin lacquer made from a vinylite base and incorporates a number of advantages not previously available in this type of finish. It possesses all the well known advantages of vinylite finishes plus excellent adhesion without the necessity of baking. The primer contains metallic corrosion inhibiting elements which prevent rusting from the underside of the lacquer film. The lacquer films are elastic, exceedingly tough, waterproof and highly corrosion resistant. Amron dries very rapidly and if desired, the final set may be hastened by forced drying. If unusual hardness of the film is desired, finishes may be baked at either high or low temperatures. They are available in any color including clear lacquer.

TEXTILE CHEMICAL

Fabrics treated with a new chemical and latex process known as Kolok, not only gives twice the wear, but they also resist shrinking and repel moths according to Dr. M. C. Teague of the General Development Division of United States Rubber Co., New York, N. Y. The process consists in depositing within the fabric minute particles of latex solids which rivet the fibers together. In this manner, durability is added without appreciably decreasing flexibility, feel, or other desirable properties.

PHOTOGRAPHIC CHEMICALS

New products that will be of interest to professional as well as amateur photographers are Merix film cleaner and moistener and Merix high gloss solution. The first of these not only cleans but also moistens the film if it has a tendency to become brittle and helps to preserve it. It can be applied on both sides of the film and will easily remove all spots, dust and fingerprints without harming the film. The high gloss solution is a special solution to give the print and enlargement a surface of highest gloss. The solution prevents scratching and sticking to dryer surfaces. Other new products of the Merix Photo Co., Chicago, Ill., are Merix metal-cleaner for electroplating and the Merix metal polish liquid.

Hydroxylamine, a most reactive compound, long recognized as useful in many organic syntheses, is now offered in the form of *three* reasonably-priced salts. The latest addition to this family of Hydroxylammonium Salts is the Chloride—the Sulfate and Acid Sulfate having been placed in commercial production last year.

In many organic syntheses utilizing Hydroxylamine the reactions are preferably carried out in a liquid medium other than water. In such cases Hydroxylammonium Chloride can be used to advantage since it is more soluble in organic liquids than the acid or neutral sulfate. For syntheses involving aqueous solutions the acid sulfate is the most economical, but the neutral sulfate is recommended where high purity is required.

The availability of Hydroxylamine at reasonable prices is stimulating active investigation of the many old as well as new reactions involving this compound. Among those mentioned in the technical and patent literature are the syntheses of indigo, azo dyes, phenyl hydrazine, the dioxime of succinic dialdehyde and many other complex organic chemicals. Hydroxylamine is also suggested for the purification of aldehydes and ketones; as a photographic developer; as a dehairing agent; and in the preparation of flotation agents. Write today for samples.

TABLE OF PROPERTIES

PRODUCT	Chemical Formula	Melting Point °C.	pH of 0.1 M Aqueous Solution at 25°C	Solubility gm. per 100 gm. at 25°C. in H_2O	in 95% C_2H_5OH	in CH_3OH
HYDROXYLAMMONIUM CHLORIDE	$NH_2OH \cdot HCl$	152 d*	3.4	94.7	10.5	17.5
HYDROXYLAMMONIUM SULFATE	$(NH_2OH)_2H_2SO_4$	162 d*	3.5	63.9	0.2	0.1
HYDROXYLAMMONIUM ACID SULFATE	$NH_2OH \cdot H_2SO_4$	Indefinite	1.6	Approx. 390	4.3	20.2

*Melts with decomposition

COMMERCIAL SOLVENTS
Corporation
17 East 42nd Street, New York, N. Y.

Chem & Met MEETINGS & CONVENTIONS

A.C.S. to Meet in September

Among the topics of interest to chemical engineers presented at recent technical meetings and conventions, the following have been abstracted in this issue:

- Engineering defense training
- Metallurgy of beryllium
- Pickling metals with ferric sulphate
- Chromate treatment of water
- Ducon air filters
- Economics of flue-gas recirculation
- Corrosion of copper alloy condenser tubes
- Ammonia for gas purification
- Fire protection engineering
- Electrocoating fabrics

COPPER-ALLOY CONDENSER TUBES

It is principally for their resistance to corrosion by water that the brasses are used in condensers, reported J. T. Kemp, American Brass Co., Waterbury, Conn., before the American Petroleum Institute. However, their resistance to attack by steam condensation on the vapor side—condensation charged with chlorides, sulphides, sulphates and neutralizers—is very important.

Prominent among the alloys used in oil refineries are: admiralty metal, red brass, cupro-nickel and aluminum brass. It was stated that practically 80 percent of the non-ferrous condenser tubes used in American petroleum refining are of admiralty metal. This tin-bearing brass has been remarkably successful with all kinds of waters and in all types of condensers.

Where oxygen saturation of tower-cooled fresh water has caused undue corrosion of the "dezincification" type, the substitution of arsenical admiralty or red brass (15 percent higher in copper) has diminished or ended this trouble. Salt waters have been handled by 70–30 cupro-nickel, with some success in refineries in the North Atlantic area, and by aluminum brass in the southern Caribbean.

Experience has shown that Muntz metal tubes should not be used in water-cooled oil-refinery condensers; that tubes of either deoxided or arsenical copper should not be used with salt or brackish waters. Red brass and the copper-silicon series of alloys (Everdur) should be included in this group. The copper-nickels may be used with either fresh or salt water; red brass, as noted previously, with fresh water if plain admiralty dezincifies rapidly. Aluminum brass is a salt-water alloy, and it does not seem to have notably better properties than admiralty in fresh water.

BERYLLIUM

Although beryllium was used as a copper alloy as early as 1897, it was not until 1932 that its use as an alloying agent with copper acquired commercial importance, according to C. B. Sawyer of the Brush Beryllium Co. of Cleveland, before the Erie Section of the American Chemical Society. So reports *Isotopics*, regional bulletin of the Society.

Beryl, the most important beryllium mineral, contains about 13 percent beryllia, 17 percent alumina, 1–2 percent each of alkaline earth and iron oxides, with the balance as silica. However, extraction of beryllium from beryl is complicated, since the mineral resists the attack of all acids except hydrofluoric. In fact, annual consumption of the ore does not now exceed 2,000 tons.

In present practice, beryl is melted at 1,600 deg. C, poured into water, ground and then treated with sulphuric acid. Ammonia is added to effect separation of ammonium alum and to obtain stable beryllium sulphate. The sulphate is ignited at 1,000–1,400 deg. C. to produce a pure beryllium oxide, which is then fed, along with carbon and copper chips, into an arc furnace at 2,000 deg. C. The melt is tapped off at intervals. This master alloy contains 4–4.5 percent of beryllium.

Metallurgically, beryllium is to copper what carbon is to steel. About 2.1 percent beryllium is soluble in copper at 800 deg. C. and quenching at this temperature produces a soft, ductile material, with a Brinell hardness of 100. Reheating this alloy to 300 deg. C. precipitates the beryllium in myriads of hard particles, reduces ductility and increases Brinell hardness to about 400. An example was given of an alloy containing 2.44 percent beryllium, 1.19 percent nickel, and the balance copper. When aged 16 hours at 380 deg. C., the tensile strength of this material was increased from 75,000 to 156,000 lb. per sq.in. and the elongation was reduced from 34 to 7 percent. Varying the heat treatment increased tensile strength to 193,000 lb. per sq.in. and reduced elongation to zero. Cold working of the metal before heat treatment increases strengthening properties.

Beryllium-copper alloy is about 50 percent stronger than its nearest competitor of the copper alloys. It has a low modulus of elasticity and a high elastic limit. High electrical conductivity also characterizes beryllium copper, with an extremely high conductivity being the case for the lower alloys containing about 0.25 percent beryllium. This low alloy is very satisfactory for welding arms and electrodes.

ENGINEERING DEFENSE TRAINING

Various aspects of engineering training in the defense program were discussed by J. I. Yellott, Illinois Institute of Technology, Chicago, before the American Society of Mechanical Engineers in Kansas City last June.

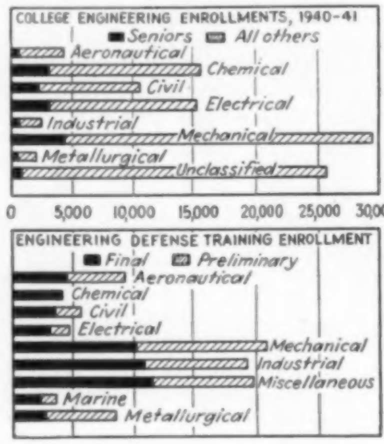
Status of the E.D.T. program as of May 31 was as follows: 139 enginering colleges out of a possible 155 are taking part. Some 1,832 course proposals have been approved, of which 224 are for full-time programs. Some 59,615 trainees have been enrolled, and an additional 53,093 are expected in courses authorized but not yet reported. A total of $3,896,180 has been disbursed, and an additional $3,687,-819 is allocated to proposed work. This training of about 112,708 individuals will cost the Federal treasury approximately $7,584,000, making an average cost per trainee of $67.

The field of chemistry is one in which

CALENDAR

SEPT. 8-12,	American Chemical Society, semi-annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.
SEPT. 16-19,	Technical Association of the Pulp and Paper Industry, fall meeting, Ann Arbor, Mich.
OCT. 1-4,	Electrochemical Society, semi-annual meeting, Hotel Knickerbocker, Chicago, Ill.
NOV. 3-5,	American Institute of Chemical Engineers, annual meeting, Cavalier Hotel, Virginia Beach, Va.
DEC. 1-6,	18th Exposition of Chemical Industries, Grand Central Palace, New York, N. Y.

employment must be greatly expanded. It was estimated (Feb. 1941) that explosives and ammunition plants alone will employ 65,000–70,000 workers, and some 4,000 chemically trained men will be needed for supervision. In addition, at least 2,000 such men will be needed by the Army for inspection work. College engineering enrollments, 1940-41, are contrasted with distribution of E.D.T. enrollments in the accompanying charts.



Engineering enrollment in colleges as compared to present E.D.T. enrollments

Ultimate effects of E.D.T. upon the engineering schools are beyond our vision at the present, stated the author. Some of these, however, may be as follows:

1. Need for technical education is being realized, as well as the neceessity of supplementing normal school work with specialized evening study.
2. Educational institutions are brought closer to industry through the contact of their full-time staff with men borrowed from industry to teach the E.D.T. classes.
3. Many E.D.T. students see the wisdom of carrying their training beyond the defense courses, and these will increase the ranks of night school students. Many students have received substantial advancement from their employers in both responsibility and remuneration, and their appreciation of the value of an engineering degree will be increased, so that a good number may be set upon the road toward such a degree.
4. Graduates of standard four-year courses will find themselves pushed with great rapidity into unusual responsibilities. Their normal position in the lower ranks of industry will be taken by men trained in certain specialized fields by E.D.T. courses, and in later years they will encounter stiff competition from the E.D.T. men who broadened their defense training.

AMMONIA IN THYLOX SYSTEM

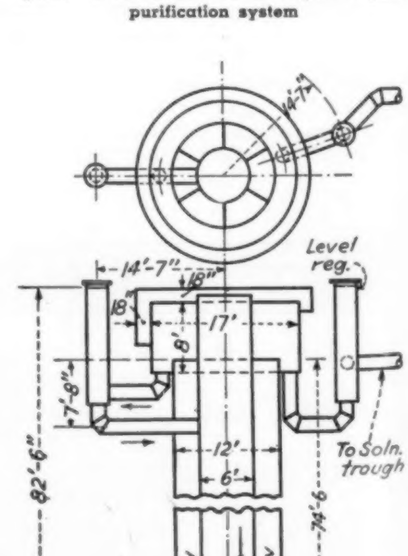
SINCE NOVEMBER 1939, the Rochester Gas & Electric Corp. has operated its Thylox liquid purification system continuously using ammonia as an alkali in place of soda ash, reported Linn B. Bowman before the American Gas Association in New York on May 21. Use of ammonia in the purification process at Rochester has resulted in substantial savings due to substituting ammonia (which has practically no value after deducting cost of recovery) in place of soda ash, which is a direct expense.

During the past sixteen months this Thylox plant purified 7,170,135 M cu.ft. of gas at an efficiency of H_2S removal of 86.2 percent and an average cost of 0.955 cents per M cu.ft. of gas purified. The sulphur produced netted a profit of 0.140 cents per M cu.ft. of gas purified, leaving the net cost of purification at 0.815 cents per M cu.ft. Savings in operating costs were largely due to elimination of soda ash, which amounted to 0.33 lb. per M cu.ft. or $19,000 per year at the Rochester plant. In addition, there were several savings difficult to evaluate, such as a saving in the cost of oxide purification due to the strongly alkaline condition of the oxide boxes. Likewise, costs were reduced by the elimination of handling, storage, and unloading of soda ash and the investment of capital in soda ash stock. Maintenance costs are also somewhat lower when using ammonia since dissolving tanks and alkali pumps are unnecessary.

To use ammonia as an alkali requires approximately 85 g. of ammonia per 100 cu.ft. in the gas at the inlet of the absorber towers. Approximately 15 percent of this ammonia is recovered in the ammonia still, since the discarded Thylox solution and the oxide-box drip water are returned to the ammonia still feed. A small amount is lost in the spent air from the high pressure thionizer, and the rest is lost in wash water in the final scrubber.

The only increase in operating expense is the maintenance of a slightly higher solution temperature, which is rather minor. In all other respects, the system operates identically and therefore the substitution of ammonia in place of soda ash has been quite satisfactory both from an operating and from an economic viewpoint. The

Pressure thionizer of the Rochester Gas & Electric Corp., where ammonia is used in place of soda ash in a Thylox liquid purification system



author included a history of the Thylox plant at Rochester as well as a detailed description of the plant and its methods of operation since ammonia has been used in place of soda ash.

FIRE PROTECTION ENGINEERING

VALUABLE information on organizing fire protection engineering courses at colleges and technical schools was contained in a committee report at the annual meeting of the National Fire Protection Association in Toronto last May. This report strongly urged that every institution of learning give some attention to such courses so that all graduates may have at least some knowledge of the fundamentals of fire protection. The scope of the recommended course can be adapted to the facilities of any educational institution or department, as the material can be considered generally or specifically from an economic or technical standpoint. The program, outlined very briefly below, was planned for a course of 32 hours of class work or two hours per week for a 16-week term:

1. Economic Consideration of Losses
   - Conservation of resources
     - Prevention of property destruction
     - Interruption to business
2. Public Interest
   - Danger to life and property
   - Public protective service
   - Codes and laws
3. Responsibility of Authorities
   - Planning and engineering
   - Fire protection organizations
4. Principles of Loss Prevention
   - General considerations
   - Preventive measures
   - Construction
     - Types and selection of types
     - Details of construction
   - Building equipment and appurtenances
     - Electrical
     - Heating and ventilating
     - Auxiliary equipment
   - Special considerations
     - Hazardous chemicals and processes
     - Flammable liquids and gases
     - Pressure equipment
     - Explosions
   - Management
     - Instruction of personnel
     - Fire brigades and drills
     - Maintenance
5. Fire Protection
   - Principles of fire extinguishment
   - Fire-hose, hydrants and sprinklers
   - Water supplies
   - Fire alarms, public and private
   - Public fire departments
6. Construction Hazards
   - Temporary sheds, light, and heat
   - Welding and cutting torches
   - Storage of combustible materials
7. Outside Fire Problems
   - Storage and handling
     - Lumber, gasoline, coal
   - Transportation
     - Railroads, marine, motor, aviation
   - Forests

Details of the above proposed course can be found in *Quarterly of the National Fire Protection Association*, April, 1941.

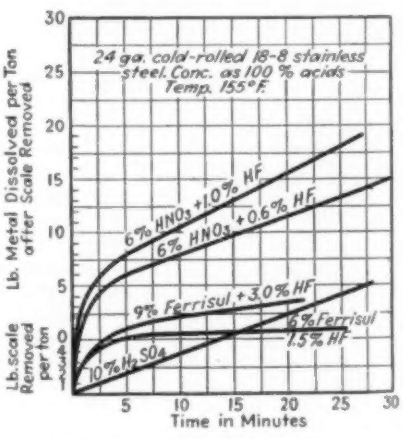
The committee canvassed by questionnaire the existing treatment of the subject of fire protection in 140 technical schools and colleges. Of 107 that replied, 62 institutions have substantially no fire prevention or fire protection instruction and at 30 others the subjects are touched on incidentally. Fairly broad instruction in fire protection fundamentals is included in 13 schools. Only one, the Illinois Institute of Technology, has a major department of fire protection en-

gineering education leading to a degree, after a 4-year course, and at one other school sufficient stress is laid on fire protection so that the entire student body is exposed to the subject.

FERRIC SULPHATE IN METAL PICKLING

FERRIC SULPHATE is being used in increasing quantities for pickling stainless steel in place of nitric acid and for copper alloys in place of sodium dichromate. So reported J. O. Percival, C. P. Dyer, and M. H. Taylor of the Merrimac Division of Monsanto Chemical Co., Everett, Mass., before the American Chemical Society in St. Louis. This trend is particularly important now that both nitrates and chromates are in the category of chemicals essential to national defense.

One of the advantages of ferric sulphate for pickling 18–8 stainless steel is that less metal is dissolved. Thus, for equal time intervals less than 5 min., the nitric-hydrofluoric bath removed twice as much metal as the ferric sulphate-hydrofluoric bath. This rapid etching of exposed metal by the nitric acid thus roughens the surface unnecessarily and makes it appear less shiny. To avoid this, it would be necessary to pickle for a matter of seconds only if using nitric-hydrofluoric acid, but in actual practice this is not usually possible. For the particular steel used in preparing the



Metal loss in various pickling agents on 24 gage cold-rolled 18-8 stainless steel, with concentration as 100 percent acids and temperature at 155° F.

accompanying graph, the scale was removed when the weight loss was about 5 lb. per ton of 24 gage sheet. Both the sulphuric and the nitric-hydrofluoric baths continued to attack at a relatively high rate even after scale removal. However, the action of ferric sulphate-hydrofluoric acid stops soon after the scale is removed and thus the steel may be left in even longer than necessary without fear of etching or high metal loss. The ferric sulphate bath, according to the authors, has the added advantage that there are no noxious NO_2 or HF fumes, an advantage to the health and efficiency of the workers.

Use of ferric sulphate baths not only produces satisfactory or superior results for both stainless steel and copper alloys, but actually reduces metal lost in the pickling process by as much as 30–40 percent on copper alloys and 50 percent or more on stainless steels.

Ferric sulphate can be used on ordinary steel when it is desired to produce a deliberate etch, such as the pregalvanizing etching of steel. In order to roughen the surface so that the zinc coat will adhere better, the steel is customarily dipped in plain H_2SO_4 to allow the hydrogen ion to oxidize part of the surface. However, part of the hydrogen gas formed tends to dissolve in the steel to an extent sufficient to cause blistering, poor adherence, and embrittlement. On the other hand, an acid solution of ferric sulphate produces little or no hydrogen and the resulting zinc coat is not only more satisfactory, but a substantial saving in pickling time also results.

During 1940, almost 50,000 tons of metal were pickled by use of this chemical and the figure is growing rapidly. From the standpoint of economics, a comparison of average prices of pickling agents on the basis of equal oxidizing power, reveals that while sulphuric acid is naturally the cheapest, ferric sulphate is less expensive than nitric acid and even less expensive than the acid-dichromate combination. When the 30–50 percent saving in metal loss is included, savings due to the use of ferric sulphate become even more pronounced.

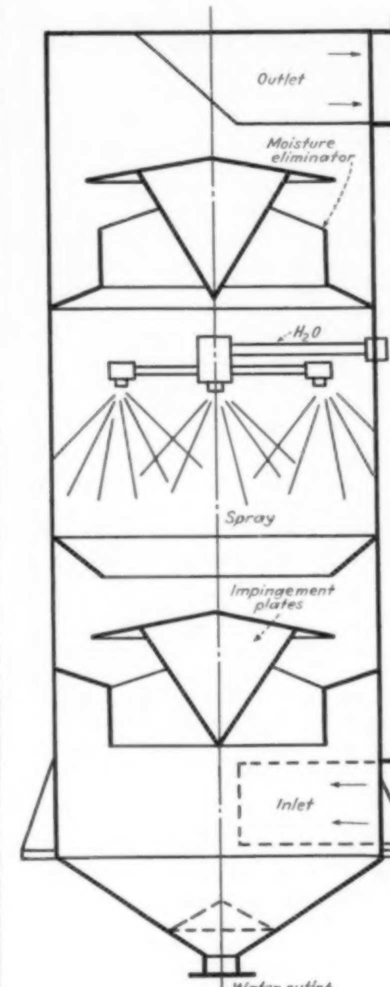
AIR WASHERS

AT A SAFE PRACTICE conference in Philadelphia sponsored by the Pennsylvania State College and the State Department of Labor and Industry, F. F. Kravath of the Abrasives Co., Philadelphia, described the operation of an improved washer for dust-contaminated air. The author reviewed types of air filters, their capabilities and failings, and their comparative worth as shown by such installations at the Abrasives Co.

Within the last year the Ducon air washer has been developed which, the author claimed, is practically as efficient as a cloth filter as a cleaning unit and is far superior as an integral part of the exhaust system. It is more compact, occupying approximately 30 percent of the space of a similar sized cloth filter. Being free of moving parts, its maintenance problem is practically non-existent. In one year of the hardest sort of service, handling the most abrasive materials manufactured, a Ducon washer at the Abrasives Co. required no maintenance whatsoever, and the only noticeable wear occurred in the cyclone section where original paint had not been quite worn away in a few spots.

Being extremely simple and compact, the cost is approximately one-half that of a similarly sized cloth filter, and erection and structural supports are also less expensive. The cost of a

complete Ducon set-up, including pump and drive, averages approximately one-third the cost of a cloth filter design. Where water pressure is not available (less than 10 lb. per sq.in. for the spray nozzles), it is necessary to provide a small centrifugal pump.



Principles of the Ducon air filter

Operating principles of the Ducon washer, shown in the accompanying drawing, involve three operations for removing dust from air. First is a cyclone at the base, then a water-spray in the central section, and finally at the top a compartment to remove excess moisture. This type is especially efficient for fine-sized abrasive dusts as the water not only wets the dust to make it heavier and hence easier to separate, but by wetting the metal parts of the walls, it acts as a lubricant to protect the metal against abrasion.

CHEMICAL TREATMENT OF WATER

CORROSION PREVENTION on the water side of refinery equipment by chemical treatment of water was discussed by W. H. Attwill, the Texas Co., Port Arthur, Tex., before the American Petroleum Institute in Tulsa. The author gave the results of chemical treatment as applied to several of the

recirculated cooling-tower systems at the Port Arthur refinery, where experience has shown that sodium hydroxide and sodium silicate treatment resulted in little, if any, reduction in the rate of corrosion.

In applying the chromate treatment to mechanical-draft cooling towers, a concentration of 500 p.p.m. of sodium dichromate (as decahydrate) was maintained in the circulating water. Sufficient caustic was added to convert the dichromate to the normal chromate and give a pH of 8.0 in the water. Small amounts of sodium hexametaphosphate were also added to give a concentration of 5–10 p.p.m. of total phosphate as PO_4. The presence of a few parts per million of metaphosphate tends to keep the condenser tubes and supply lines free from mineral and corrosion deposits.

In one of the newer cooling-tower systems receiving the chromate treatment, more than 11,000 red-brass condenser tubes have been in water service for more than 18 months without any replacement; and in a second system of more than 3,000 red-brass tubes no failures have occurred in 26 months. Examination of the equipment has shown very little corrosion in the steel and cast-iron water-supply line and cast-iron condenser heads.

Chemical costs of the chromate treatment in the mechanical-draft cooling towers have averaged about \$35 per month per 1000 gal. per min. of water circulated, but this cost is justified amply by reduction in corrosion in condenser tubes and water supply lines, better heat-transfer rates, fewer shutdowns and generally better operation of the refining units. The cost of chromate treatment in natural-draft towers has averaged approximately \$20 per month per 1000 gal. per min. of water circulated.

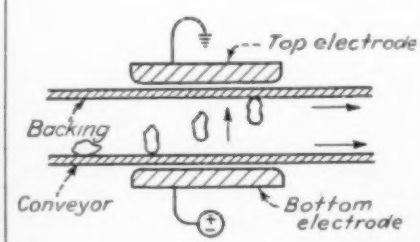
Threshold treatment was started in August, 1939. In this treatment a concentration of 2–5 p.p.m. of sodium hexametaphosphate is maintained in the circulating water by the addition of the required amount of hexametaphosphate. Sufficient caustic is added to maintain a pH value between 7.5–8.0. Although the corrosion-reduction properties of this treatment have not been well established, there are indications that some reduction in corrosion results, but definitely less than with the chromate treatment. Threshold treatment has been recommended for the control of cold-water corrosion. Cost of the threshold treatment averaged \$10 a month per 1000 gal. per min. of water circulated.

ELECTROCOATING FABRICS

ELECTROCOATING FABRICS, a process first adapted in 1939 to the making of dress goods and other fabrics, was discussed by J. O. Amstuz of the Behr-Manning Corp., Troy, N. Y., before the American Society of Textile Chemists and Colorists last May in Rochelle Park, N. J.

Equipment for electrocoating is rela-

tively simple. Small crushed mineral particles or fibers are carried by belt conveyor to a strong electrostatic field. Moving over the belt conveyor is a web of adhesively-coated paper or cloth. Two electrodes, similar to condenser plates, are required to establish the electrostatic field. One of these is located underneath the conveyor belt while the other is placed above the backing, as shown in the figure. The top electrode is grounded while the bottom one is connected to the high tension terminal of the transformer or a kenetron rectifier set. Voltage is varied from 20,000–70,000 v. while the electrode spacing is held from 0.5–1.5 in.



Principles of electrocoating fabrics, showing backing, conveyors and electrostatic field. With rayon, 300,000 fibers per sq.in. can be obtained by this process

Textile chemists have difficult problems to solve in producing fibers which have suitable characteristics for electrocoating. Dyeing, bleaching and drying must be done so that the required characteristics for electrocoating are not impaired. Dyestuffs and dye methods must be adjusted to maintain these fiber characteristics, and the moisture content, for instance, must be under accurate control.

It was pointed out that the wear of fabrics is approximately proportional to the fiber density. With rayon fibers of 3.5 denier, it is possible to obtain fiber densities of 250,000–300,000 fibers per sq.in. No woven fabrics can be made as dense, which is one reason why electrocoating fabrics outwear the woven ones by surprising margin. Standard wear tests show ratios of 1 to 3 in favor of electrocoated fabrics.

Serious consideration must be given to the viscosity of the adhesives so that the required penetration will result from the velocity which the particles attain under the influence of the electrostatic field. Where this velocity is great, as with particles of small mass under the influence of a powerful field, the viscosity can be at its practical maximum. Any sacrifice of this velocity must be compensated for by a reduction in viscosity of the adhesive. Such materials as natural and synthetic rubber, reclaims, and resins are adaptable to the process in the form of solutions or dispersions. Cattle-hair fibers are held onto the backing with rubber cement, but the curing of latex and rubber cement is critical and must be under accurate control.

SELECTIONS FROM FOREIGN LITERATURE

NICKEL PLATE ON IRON AND COPPER

HARD lustrous nickel deposits are formed on copper and iron from electrolyte baths containing certain inorganic colloids. Tests were made with sulphur sol, silver sol, red and blue gold sols, positive and negative silver halide sols and Prussian blue hydrosol. The sulphur sol gave a dull, patchy plate with poor adhesion. Positive and negative sols of silver chloride, bromide and iodide gave only slightly better deposits. The best deposits were formed from silver and gold sols; they were hard and lustrous, with good adhesion and less pitting than with other sols. Nickel plate from these sols takes a high polish. Prussian blue hydrosol also gave hard, bright plate but with more pitting than from silver or gold sols. The cause of pitting is being investigated. Plating was carried out at 35 deg. C. with a current of 0.3 amp. In similar tests with selenium, iodine, aluminum hydroxide and ferric hydroxide sols in baths for nickel plating copper the metal hydroxide sols gave hard, bright, fine-grained nickel deposits.

Digest from "Effect of Inorganic Colloids on the Electro-deposition of Nickel on Copper", by V. S. Puri and G. C. Juneja, and "Electrodeposition of Nickel on Iron and the Effect of Colloids on the Nature of Deposit," by V. S. Puri and F. R. Mahmood Alvi, *Journal of the Indian Chemical Society* **17**, 581, 699, 1941. (Published in India.)

BASE EXCHANGE WATER SOFTENERS

THE TEMPERATURE influence in operating base exchange water softeners is significant partly because water supplies are treated at all temperatures from winter cold to summer warmth, and partly because it would sometimes be helpful in industrial practice if water in relatively small quantities could be softened at elevated temperatures. Temperature effects have therefore been studied with 5 types of base exchange softeners:

1. Treated coal.
2. Treated fuller's earth.
3. A quebracho-tannin resin.
4. Greensand.
5. Synthetic zeolites (2 varieties).

Of these reagents the only one which had a higher softening capacity for hot than for cold water was the quebracho-tannin resin. Treated coal, greensand and synthetic zeolites are nearly independent of temperature up to about 122 deg. F. but a further temperature rise to 158 deg. F. seriously impaired their efficiency. Fuller's earth shows its temperature sensitivity earlier, decreasing gradually in efficiency all along the rising temperature curve. The quebracho-tannin resin was independent of temperature up to about 95 deg. F. The temperature effects on greensand and the synthetic resin are compared in the table, in which base exchange capacity is expressed in lb. of CaO removed per 100 lb. of hard water. Hardness is expressed in parts per 100,000, calculated as $CaCO_3$.

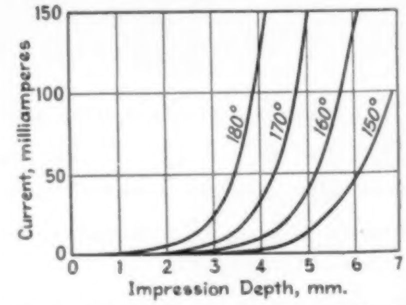
Digest from "Effect of Temperature on the Exchange Capacities of Some Base Exchange Materials Used in Water Softening," by H. Ingleson and A. Harrison, *Journal of the Society of Chemical Industry* **60**, 87, 1941. (Published in England.)

Temperature effects with two types of base exchange water softeners

Greensand				Quebracho-Tannin Resin			
Temp. deg. C.	Hardness	pH	CaO removed	Temp. deg. C.	Hardness	pH	CaO removed
16.5	25.7	7.5	0.77	16.1	25.3	7.5	1.63
3.3	25.3	7.5	0.78	3.3	25.3	7.5	1.60
36.0	24.8	8.2	0.77	36.0	24.8	8.2	1.67
51.6	23.6	8.7	0.74	51.6	23.6	8.7	1.97
68.6	16.6	8.2	0.38	68.6	16.6	8.2	1.90
20.3	21.3	7.5	0.22	20.3	21.3	7.5	1.85

INSULATED WIRE

EXPERIENCE has shown that the mechanical properties of insulating enamel baked on wire are the same after a slow low temperature bake as after a correspondingly shorter high temperature bake. Tests to confirm this point were made with insulating enamels on iron panels instead of wire. In one case, for example, an enamel gave films with the same mechanical properties when baked 15 min. at 180, 45 min. at 170 or 135 min. at 150 deg. C. All the tests were made with phenolic resin enamels, applied by dipping. Adhesion, tensile strength, elongation and breakdown resistance were measured. A good insulating coating on wire should have a breakdown strength of about 400 volts in



Effect of baking temperature on single coats of phenolic resin insulating enamel

a film 0.01 mm. thick. Film thickness should be kept as small as possible in order to permit the maximum number of ampere windings in a coil of a given size. It has been found that the current passing through the film while it is being deformed is an excellent criterion of film quality. If the film is wet with an electrolyte during deformation the Erichsen tester can be used to good advantage for this purpose. The chart shows some typical

curves, in terms of milliamperes and degree of deformation (impression depth in mm.), for a single coat of a phenolic resin insulating enamel on a thin iron panel. These curves show the effect of baking temperature.

Digest from "Testing the Behavior of Insulating Enamels (Wire Varnish) With the Erichsen Tester," by Herbert Niesen, *Elektrotechnische Zeitschrift* 62, 73, 1941. (Published in Germany.)

VISCOSITY OF ALUMINUM ALLOYS

Capillary viscometers have been successfully used for some metals but with aluminum and its alloys the capillary is quickly clogged by particles of alumina suspended in the melt. The oscillation damping method, used for molten salts by Dantuma, has now been successfully adapted to the viscometry of aluminum and its alloys.

In this method the damping effect (logarithmic decrement) is determined for the torsional oscillation of a steel ball (about 23 mm. in diameter) hung from a fine steel wire. To prevent corrosion, the ball and wire were coated with waterglass pigmented with zinc oxide and graphite. The instrument was checked against water and benzene. Good results were obtained in aluminum and Silumin (Si = 12.3, Fe = 0.44, Mg = 0.01 percent) up to 800 deg. C., beyond which the carnallite flux ceased to protect the surface adequately. Viscosities of aluminum melts (in poises) range from 0.01392 at 800 deg. C. to 0.06761 at 670 deg. C. In Silumin melts the range is from 0.01061 at 775 deg. to 0.05085 at 620 deg. C.

Digest from "Determining Viscosity of Molten Aluminum and its Alloys," by E. V. Polyak and S. V. Sergeev, *Comptes rendus de l'academie des sciences de l'URSS* 30, 137, 1941. (Published in Russia.)

PORCELAIN AS A METAL SUBSTITUTE

Modern methods which permit porcelain shapes to be accurately formed to specified dimensions during or after manufacture have opened new fields of use to porcelain. Whereas accuracy was formerly only about 5 percent for turned or molded porcelain shapes, and 1.5 to 3 percent for extruded shapes, it is now possible to meet tolerances as fine as 0.01 mm. by precision grinding. Valves, faucets, 2-way and 3-way stopcocks can be ground to an excellent fit. Valves are made in armored and all-porcelain designs. Rolls for various kinds of machines are also made of porcelain.

Somewhat surprisingly, hard porcelain is also being used successfully in heat exchangers. The low heat conductivity bars this material from heat exchange with a high temperature gradient and rapid flow, but with a low temperature gradient and slow flow an effect comparable to that of metal exchangers can be achieved. This is especially true since the development of "Heschotherm" which far surpasses all other ceramic materials in heat conductivity. Instead of 1.3 or 1.4

(the usual thermal conductivity of porcelain) "Heschotherm" has a conductivity of 6.5 kcal/m/hr/°C. This means that a large bulky heat exchanger is not necessary for duplicating the performance of a metal exchanger.

Digest from "Hard Porcelain as a Substitute Material," by Wallich, *Wochenblatt für Papierfabrikation* 72, 252, 1941. (Published in Germany.)

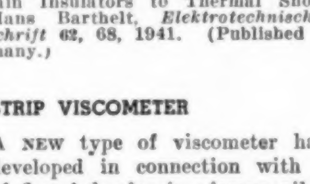
HEAT SHOCK EFFECTS ON PORCELAIN INSULATORS

THERMAL shock testing of porcelain insulators causes hidden cracks such as might escape ordinary inspection. These cracks may result from temperature fluctuations as small as 70 deg. C. They appear most commonly inside the "fish skin" along the cemented union. Often they lie in a plane perpendicular to the insulator axis. Fine cracks are difficult to detect in porcelain, especially internal cracks which do not come to the surface. Hence the test is likely to damage insulators and yet leave them in condition to be passed by inspectors. A test more nearly approaching natural exposure conditions is proposed, namely heating the insulator superficially to 100 deg. C. (as might conceivably occur in direct sunlight), then spraying with water to imitate a sudden rain.

Digest from "Response of Large Porcelain Insulators to Thermal Shock," by Hans Barthelt, *Elektrotechnische Zeitschrift* 62, 68, 1941. (Published in Germany.)

STRIP VISCOMETER

A NEW type of viscometer has been developed in connection with studies of flow behavior in viscous oils as influenced by suspended pigments. The new instrument is adaptable to measuring viscosity of viscous liquids and pastes at high rates of shear, and is subject to accurate temperature control.



As shown in the drawing, *M* represents two metal blocks with rounded edges; they are spaced 150 microns apart by spacers *S*, and the slot be-

tween them is 25 mm. deep. The test strip can be warmed or cooled, as desired, by passing water through the instrument by means of tubes *W*. The test strip is weighted at *G* sufficiently to make it slide, and is held taut by means of a counterweight which is attached by a thread at *g*. The strip is 30 mm. wide, and about 800 mm. long. It is 50 microns thick, leaving 50 microns clearance on each side in the slot between blocks. The strip may be made of cellulose triacetate. The viscous liquid or pigment suspension to be tested is held in the depression in the blocks on either side of the test strip. The rate at which the strip slides through the slot under a given load is a measure of viscosity of the liquid or suspension. Viscosity of a pigment-free oil can be correlated with that of the same oil with a pigment: simple logarithmic relation can be established in each case.

Digest from "The Strip Viscometer, A New Instrument," by F. Wachholtz, *Chemische Fabrik* **14**, 155, 1941. (Published in Germany.)

PACKING REACTION TOWERS

DISCONTINUITIES in liquid: vapor systems in packed towers, due to channeling, lamination or other faults in distribution, are avoided by a new packing system in which the packing shapes (e. g. rings with height equal to diameter) are shaken down by localized tapping to give an arrangement which assures uniform liquid flow and wetting of the rings. Shaking is carried out in circles proceeding from the wall of the tower, but to prevent channeling inward toward the center intermediate layers are shaken upward, downward and horizontally from the center of the tower. The advantages of the new packing system are increased absorption capacity, sharper separation, increased heat transfer, intensified scrubbing effect, increased tower capacity for unit size, elimination of complicated and expensive heat exchange and flow devices, and economies in tower installation and operating costs.

Digest from "A New Process for Packing Reaction Towers by Shaking the Packing," by G. Schneider, *Chemische Fabrik* **14**, 111, 1941. (Published in Germany.)

BEARING METALS

IN MODERN machine design the choice of bearing metals depends on specific physical conditions of lubrication and load. There are three standard bearing metals which meet many requirements, and a variety of special metals. The three standards are:

Standard Metal: lead 79.20, antimony 14, tin 5.30, copper 1.50 percent.

Regular Metal: tin 83.30, antimony 11.10, copper 5.60 percent.

Railway Metal: lead 98.64, calcium 0.70, sodium 0.62, lithium 0.04 aluminum 0.20 percent.

Among the best of the special bearing metals is "Metta No. 44" which is mainly lead with a special harden-

ing ingredient, avoiding the use of nickel which tends to make bearings too easy to scratch in service. Without the expense of tin, Metta No. 44 is useful instead of white metal in a great variety of bearings.

The choice of a bearing metal depends partly on the type and variability of load and partly on the size and curvature of the groove in which the bearing operates. The type of lubricant to be used must also be considered. Colloidal graphite is a desirable ingredient at high specific pressures and low speeds, while clear light distillates are best for light loads at high speeds.

Digest from "Bearing Metals," by E. Belani, *Wochenblatt für Papierfabrikation* **72**, 240, 1941. (Published in Germany.)

MECHANISM OF CEMENT BURNING

THE HEAT of hydration of raw mix in a cement kiln as a significant factor in the mechanism of burning clinker and in relation to the properties of the final product. Heats of hydration were measured for a number of samples by comparing the heat of solution of the powder before and after hydration. A comparison of the heat absorbed by raw mix in wet and dry process kilns gave these results (calories per gram):

	Heat of solution		Total	Heat	
	Clinker	Raw mix	heat absorbed	of hydration	Fixed heat
Dry	612.8	− 331.7	= 281.1	= 109.4	+ 171.7
Wet	626.1	− 256.6	= 369.5	= 144.3	+ 226.2

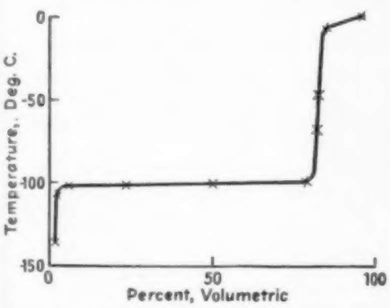
In both cases the total heat absorption is divided in about the same proportion 39 percent to hydrate the powder and 61 percent fixed by the clinker as latent energy. In the dry kiln process flue dust and Cottrell dust are recovered. Tests of tensile and compressive strength showed that in general strength increases as total absorbed heat increases, but that the increase is not proportional. Instead, the last small increment of absorbed heat greatly affects the strength of the finished cement. Nearly all the product in the kiln is quick setting, but a slow setting tendency becomes apparent when the clinker zone is approached.

Digest from "Researches on the Burning Mechanism in the Rotary Cement Kiln. XI. Heat of Hydration of Raw Meal in the Rotary Cement Kiln and its Corresponding Physical Properties," by T. Yoshii, *Journal of the Society of Chemical Industry, Japan* **44**, 15B, 1941. (Published in Japan.)

BUTYLENES FROM ETHYLENE

CATALYTIC dimerization of ethylene in presence of nickel (reduced in hydrogen 3 hours at 400 deg. C.) yields approximately equal proportions of 1-butylene and 2-butylene. Since 2-butylene exists in *cis* and *trans* isomers their proportions were also investigated. Again division was approximately equal. By carrying on th reaction under optimum condition (low space velocity and high temperature) yields of butylene between 7

and 80 percent of the reacted gas are obtained. About 25 percent goes to form higher polymers while the loss by side reactions is only 2-3 percent. A kinetic study of the reaction showed that the rate of catalytic dimerization is directly proportional to the partial pressure of ethylene in the vapor phase. The apparent energy of activation in the reaction is about 10,500 cal. A typical distillation curve, from



Typical distillation curve of butylene from ethylene

fractionation in a Podbielniak column, is shown to illustrate the composition of the gas. The small fraction of gaseous decomposition products and the larger fraction of higher boiling polymers are clearly evident at the ends of the butylene portion of the curve.

Digest from "Kinetics of Catalytic Dimerization of Ethylene," by S. Ya. Pshezhetskii and A. T. Gladyshev, *Zhurnal Fizicheskoi Khimii* 15, 333, 1941. (Published in Russia.)

FELTING CAPACITY OF WOOL

SORPTION of hydrogen by wool has all the characteristics of adsorption, but sorption of air is distinctly different. Equilibrium is reached much more slowly, presumably because oxygen in the adsorbed air oxidizes the wool fiber, thus releasing part of the surface to adsorb more air. Thus a process of chemosorption is set up, as has been demonstrated experimentally. The reason it does not continue until oxidation destroys the fiber is that nitrogen, the main component of the adsorbed air, builds up a protective layer through which oxygen must diffuse to get at the fiber. Because of this protection wool can be kept for years without serious deterioration.

Dyeing and felting influence the chemosorption process, apparently independently of each other. Dyeing increases chemosorption of air, probably by enlarging the micelle surface and changing its character. Felting decreases adsorption of hydrogen, both in dyed and undyed wool. Its effect on chemosorption of air is not entirely clear, but wet wool can be felted by heating in air at about 100 deg. C. whereas heating in absence of air has no felting effect whatever. In general the effect of felting is to decrease the total micelle surface of the wool fiber.

Digest from "Density and Sorptive Capacity of Some Samples of Cotton, Silk and Wool," by P. M. Heertjes, *Recueil des travaux chimiques des Pays-Bas* 60, 91, 1941. (Published in Holland.)

Chem & Met BOOKSHELF

New Titles, Editions and Authors

PETROLEUM'S ENCYCLOPEDIA

DONE IN OIL. By *David D. Leven*. Published by the Ranger Press, New York. 1084 pages. Price $10.

Reviewed by *S. D. Kirkpatrick*.

IN MANY respects the petroleum industry has been America's greatest contribution to modern civilization. It has brought wealth, power, comfort, health and security to millions of people. In turn it has drawn heavily on the human, financial and scientific as well as the natural resources of the world. Behind the brief life-span of this all-important industry is a story that touches somewhere on the lives of all of us. To encompass all of this between the covers of a single book seems like an impossible task, yet that is what this author has attempted and largely accomplished.

Virtually a one-volume encyclopedia of the petroleum industry, the book covers every phase of oil's activities from the genesis of its geology to its marketing and utilization. The general approach is from the economic viewpoint and the first of its four major sections is concerned with the part petroleum plays in national and international economy. Likewise Sections 4, 5 and 6 are concerned with financing of the oil industry, the oil royalty business and the regulation of its securities and markets. Thus almost two-thirds of the volume has been devoted to what might be regarded as a glorified, documented and interpreted edition of A.P.I.'s famous "Petroleum Facts and Figures." But the author has done something more than put flesh and blood on that statistical skeleton. He has made it an intensely interesting, readable life story of Old King Crude and all his descendants.

Finding and producing the oil and transporting, refining and marketing it comprise the two remaining sections of about 360 pages. Here again the major approach has been largely descriptive and statistical. One gets the impression that the author has been more at home in the oil fields than in the refineries. His accounts of "Oil Science" in the application of geo-physical and other modern methods of exploration show detailed as well as broad and practical knowledge of oil structures and of the ways in which oil is found and missed. On the other hand, this reviewer's impression of the two score pages devoted to oil refining is that the treatment has been much too general and all too sketchy to do justice to the really great contributions of chemistry and engineering in creating a whole new field of technology. Perhaps exactly the opposite viewpoint might be held by the geologist, the oil producer or the investor, each thinking in terms of his own special interest.

As Mr. Leven points out in his very modest foreword, the publishers of "Done in Oil" have spared no expense in providing a proper setting for "the vast panorama of King Crude's ascendancy." The book is beautifully bound in flexible leatherette covers, with striking three-color maps on the front and back fly-leaves. Thirty full-page examples of the photographic art of Robert Yarnall Richie add interest and value to the volume. Literally hundred of charts, tables and maps testify to the author's own craftsmanship. Unusual, but useful and welcome in a volume of this sort, are a 40-page glossary of terms used in the oil industry, 33 pages of pertinent appendixes and bibliographies and a comprehensive index of 43 pages.

THE FEDERAL LABOR LAWS. By *R. L. Greenman* and *Leslie Sanders*. Published by National Foremen's Institute, Deep River, Conn. 72 pages. Price $1.

THREE Federal laws are discussed in this inexpensive guide for supervisors and foremen. They are the Wagner Act, the Wages and Hours Act and the Walsh-Healy Act. Written in non-technical language, the discussions describe the laws and point out what must be done by supervisors and foremen, as representatives of employers, to comply with the legal requirements.

MODERN GLASS PRACTICE. Revised edition. By *S. R. Scholes*. Published by Industrial Publications, Inc., Chicago, Ill. 289 pages. Price $6.

PLANNED as a textbook of glass technology for college students and as a reference book for executives and operatives, the first edition contained a wealth of information on the chemistry, physics and technology of glass. The revision, of larger format, records advances in the art.

Because of the audience for which it is intended, the book contains discussions of elementary matters as well as technical descriptions of materials, methods and products. Opening with a discussion of the glassy state, the book continues through the chemistry and physics of glass and glassmaking to treatment of raw materials, batches and calculations. Chapters on combustion, fuels and furnaces, glassworking, annealing, decoration, and other pertinent aspects are included in the two dozen which make the book a complete reference and guide. Well indexed.

RUBBER AND ITS USE. By *Harry L. Fisher*. Published by Chemical Publishing Co., Brooklyn, N. Y. 128 pages. Price $2.25.

FOR those of us, outside the rubber industry, whose interest in rubber is more or less academic, this little book offers an outline and description of the industry. History, production, properties and manufacturing are all covered in interesting narrative fashion. Chapters on synthetic rubbers and rubber derivatives conclude the book. Lists of references for supplementary reading are included.

METHODS OF ANALYSIS OF COAL AND COKE. Published by Chemical Publishing Co., Inc., Brooklyn, N.Y., 85 pages. Price $1.50.

Reviewed by *W. A. Selvig*.

THESE methods of analysis of coal and coke were standardized primarily for use by the Fuel Research Organization of the British Department of Scientific and Industrial Research in connection with their survey of the physical and chemical properties of British coals. The methods do not differ fundamentally from those of the British Standards Institution but in general they are much more detailed and include methods not given in the British Standards Institution Specifications.

Part I, covering 68 pages, deals with coal and includes methods for total moisture (including a toluene distillation method), proximate and ultimate analysis, calorific value, sulphur forms, chlorine, phosphorus, arsenic and carbon dioxide. The Gray-King carbonization assay of coal for yields of coke, gas, and by-products is described for tests to simulate both low and high temperature carbonization conditions.

Part 2, comprising 9 pages, covers coke and gives methods for total moisture, proximate and ultimate analysis, chlorine, phosphorus, arsenic and calorific value. Many of these methods are essentially the same as given for coal. A method is included for determination of the calorific value of the volatile matter remaining in high temperature coke.

Four appendixes cover determination of the agglutinating value of coal, reproducibility of analytical results, recommended method for reporting analyses, and a mechanical mixing device for preparation of laboratory samples.

Naturally these British methods differ more or less from standardized

AMERICA'S SECRET WEAPON

e brains and skill of our emical Industry surpass those any Chemical Industry on Earth

Lowell Thomas

MAGIC IS THE WORD FOR CHEMISTRY. And magic is the word to express the job the Chemical Industry is doing to help defend America.

Before I began my tour to collect material for this article, I thought of the chemical industry as full of new developments. But my imagination limped behind the facts. Chemistry, to me, is magic—a magic which chemists call Research and on which the American chemical industry spends $50,000,000 a year.

A magic by which the United States has been made self-sufficient in materials, in techniques and in production of practically every chemical vital for defense.

Turn '41 backwards and you get '14. In '14, and even in '17, when we entered the war, there were forty-two "strategic materials" which we had to import. Today there are but fourteen, for most of which chemical research has created substitutes from domestic raw materials.

In '14, we made less than 10% of our dyes. In '41, we can make them all. In '14, we imported all our nitrates—essential for explosives, fertilizer and other purposes. In '41, we can produce, in American plants, all we need. In '14, camphor, used in medicine, photo film and plastics, was all imported from Formosa at Japan's monopolistic prices. In '41, we synthesize it from stumps and slash pine at a tenth the cost.

In '14, we imported practically all our photo-chemicals, optical glass, potash, phosphorus and even shellac. We were dependent upon Germany for many of our drugs, antitoxins and prophylactics; as well as for urea—essential for fertilizer, medicines and plastics.

In '41, we produce adequate supplies of all these things domestically.

In brief, the situation in '14 has been reversed in '41. Today our chemical industry has a production greater than that of England, Germany, Japan, Italy and Russia combined.

THROUGH RESEARCH ***the Chemical Industry is helping to make America self-sufficient in all strategic materials necessary for national defense. This great industry spends $50,000,000 a year on research alone.***

There is, however, one tremendously important exception—military explosives. This is the bottleneck of bottlenecks. What is being done about it confirms my opening sentence that "magic is the word for chemistry."

But let President W. S. Carpenter, Jr., of du Pont, present the proportions of the problem:

"In September, 1939, du Pont employed only about 500 men in making military explosives," Mr. Carpenter told me. "The defense program called on du Pont to create new TNT and smokeless-powder plants which would employ thirty thousand men. These plants to be ready, staffed and producing this year."

"Sounds impossible," I said.

Mr. Carpenter replied: "Since 1914, the chemical industry has invented or synthesized thousands of products, and created the capacity to manufacture them. We're used to exacting demands."

"But to magnify plant and personnel sixty times within fifteen months is . . . "

"Our primary defense job," was the quiet rejoinder. "It's being done. The plant we built and are now operating at Memphis was finished three months ahead of schedule. The $75,000,000 plant we are erecting for the Government at Charlestown, Indiana, started operations a month earlier than specified. And other Government plants in Illinois, West Virginia, Alabama, New York and Maryland are similarly ahead of schedule."

"You must have a staff of Aladdins rubbing lamps in three 8-hour shifts," I remarked.

A Skeleton Comes to Life

"No, not that," smiled Mr. Carpenter, "but we have a job to do and are giving everything we have to doing it. We surveyed our peacetime organization for men skilled in high explosives. Since—contrary to general belief—our peacetime production of munitions is only about 2% of our total business, what we got was a skeleton staff for this enormous job. But it was a very live skeleton. Staffs were recruited. Adequate personnel has been trained and organized. Speed was a dominant consideration."

(Continued on next page)

NOTE TO READERS:

The article reprinted here appeared, as Johns-Manville paid advertising, on pages 45 and 46 of the August 2nd issue of the *Saturday Evening Post*. It is one of a series by well-known writers on the defense achievements of the major industries of the country.

Because of our long and close association with these industries, Johns-Manville knows, at first hand, the job which Industry, under free enterprise, is doing in building National Defense. But we are convinced that too few people realize the magnitude of that job and, like other manufacturers, we believe it is vitally important to the future of the American System that this story be told to the widest possible audience.

It is our sincere hope that this series in the *Saturday Evening Post*, and a similar campaign which is appearing in newspapers, will be helpful in informing the public of the indispensable job American Industry is doing in this time of our greatest National Emergency.

Johns-Manville

Photo courtesy U.S. Army Signal Corps

NO "DUDS" HERE. ***This great 8-inch Army railway gun can go into action wherever railroad tracks will take it on the North American Continent.***

This is the third of a series of advertisements sponsored and paid for by Johns-Manville. For more than 80 years this company has been serving America's basic industries.

How indispensable these industries are to the American Way in time of peace is generally recognized. This series is to help inform the public of the indispensable job these industries are doing in this time of great National Emergency.

Johns-Manville is proud of the contributions its products are making in helping the chemical as well as other industries produce defense material quickly and at the lowest possible cost.

AMERICA'S SECRET WEAPON

(Continued from preceding page)

"It's splendid," I said.

"Not bad," said Mr. Carpenter, "but you'll find our record has been equaled by plenty of other companies."

(That is true. For instance, Hercules Powder Company is ahead of schedule with the Government's $44,000,000 ordnance works at Radford, Virginia. And the Trojan and Atlas Companies, faced with the same problem of tremendous expansion, are long strides in advance of the staggering requirements.)

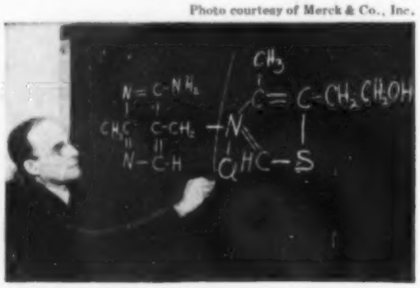
"With such a record of accomplishment," I suggested to Mr. Carpenter, "the military explosives manufacturers are entitled to the profits they'll make out of the job."

"Let's explode that idea of high profits in military explosives right now," Mr. Carpenter exclaimed. "As nearly as the cost of the effort can be estimated, contracts between the United States and this company permit a profit to the company of less than 2 per cent. Peacetime business is more profitable."

Even Greater Contributions

Because it is the most immediate defense problem of the chemical industry, I have

Photo courtesy of Merck & Co., Inc.



HERE'S THE WAY *a vitamin looks to a chemist. You may "know your vitamins," but did you know that Vitamin B_1 has this complicated chemical structure?*

presented the munitions story first. Actually it is not the industry's major contribution, unless you give "munitions" the broad meaning given to it by Edgar M. Queeny, President of St. Louis's Monsanto Chemical Company.

"You can't limit 'munitions' to powder, shell and guns," said Mr. Queeny. "Munitions means food and clothing, medicine and housing and cigarettes for soldiers. It also means everything contributing to civilian health, efficiency and morale. And there isn't any industry that supplies more of *those* munitions than the chemical industry.

"At Monsanto, Tennessee, our electric furnaces are turning out phosphorus by the carload. In its pure form or in phosphates, it goes into food, dentifrices, soaps and steel; it's used for tracer bullets and smoke screens.

"Here in St. Louis we're making sulfanilamide by the ton to fight infections, in camp or at home, and other medicinals we're pouring forth by carloads.

"Monsanto's plastic, Saflex, is used in windshields for planes, tanks and armored cars.

"Many of our synthetics and plastics are used in plane and ship instruments.

"One of our plants is engaged, without profit, in making chemicals for the protection of troops against poison gas. We are even with, or ahead of, schedule on practically all our defense production."

For the general picture of the chemical industry in defense, I went to Warren W. Watson, secretary of the Manufacturing Chemists' Association. Through this Association every major chemical company in America clears its measuring standards and checks new findings. Almost 100 companies are members.

How We Stand

"Let's list the essentials and see how we stand in the industry," said Mr. Watson.

"LABOR—expert, highly paid, generally content and co-operative. Strikes have been few.

"MATERIALS—the basic materials used in industrial chemistry can be reduced to Coal, Air, Water, Petroleum and Natural Gas, Vegetable and Animal Oils, Phosphate Matrix, Limestone, Sulfur, Salt, Cotton and Wood. Of all of these there is a limitless domestic supply.

"BRAINS—I believe the directive minds in the chemical industry are unexcelled anywhere. As to the scientific corps: Though the chemical industry is nineteenth among American industries in volume of product, it is *first* in the proportion of its total revenues spent on laboratories and research—more than nine thousand explorers of the infinite and the infinitesimal. This one private industry has spent, in a quarter-century, about as much money on research as all the laboratories of the Federal Government and the forty-eight States! Relative to its resources, it has spent twenty-eight times as much . . . AND THAT MAGNIFICENT RESEARCH IS NOW CONCENTRATING ON DEFENSE.

"I think the Army and Navy Munitions Board and the O.P.M. will testify that our industry has not only co-operated efficiently with the defense program, but has anticipated many of the demands defense would make upon it."

Many interviews and much observation convince me that Mr. Watson's opinion is not wishful thinking, but solid factual statement. For example—take food.

I learned from George W. Merck, President of Merck & Co., Inc., how vitamins are synthesized; so that Vitamin B_1, for example, which formerly required a ton of Chinese rice polishings to produce five grams, is now made from domestic chemicals at about a fiftieth the cost. And Mr. Merck told me how this was related to defense, and how the Army and Navy will supply the fighting forces with bread, chocolate and other foods fortified with vitamins essential to health and energy.

Also, Mr. Merck explained that "synthetic" does not mean "artificial."

"Synthetics," said Mr. Merck, "are not 'ersatz.' They are either chemical identities of the natural product, or they are completely new materials."

L. M. Rossi, of the Bakelite Corporation, a Unit of Union Carbide and Carbon Corporation, elucidated further.

"Synthetics should be called 'creatives,'" he suggested. "Look at plastics. Bakelite plastics and those created by other chemical research laboratories enter into every phase of defense. Transparent plastics like 'Plexiglas' and 'Lucite' make plane windshields and windows. Plastics, synthesized from coal, cotton, carbolic acid, formaldehyde, petroleum and milk, go into range finders, bomb sights, shell noses, timing gears and machine-gun drums. Some of these plastics are fire-resistant and unaffected by oils, gases, acids or caustics.

"In liquid form, they make quick-drying lacquers and finishes so permanent that acids can eat away the metal they coat and leave the plastic finish intact!

"Speeds of three and four hundred miles an hour actually strip the finest spar varnish off airplane wings and slow planes down as much as 10%. Synthetic lacquers, on the other hand, stay put—and reduce wind resistance.

"The use of these new materials releases fine steels, aluminum, tungsten and other vital metals for *other* defense needs."

President J. A. Rafferty of Carbide and Carbon Chemicals Corporation, another Unit of Union Carbide and Carbon Corporation, told me of Union Carbide's defense activities—the production of oxygen for high-altitude planes and for oxyacetylene torches, electrodes for steel furnaces and for welding ships, tanks and airplane frames. But it was only from the 1940 report to the stockholders that I learned Union Carbide and Carbon was spending $35,000,000 of its own funds largely for defense production.

Corporate policy forbids personal quotation of officials of Allied Chemicals and the American Cyanamid Company, but I can report that defense has priority in their minds—and their plants. I heard from Cyanamid's executives how it pioneered in dyes twenty-five years ago and helped to establish the self-sufficient dye industry we have today. I know how Allied's nitrogen plants at Hopewell, Va., and Syracuse, N. Y., helped to make us independent of a foreign nitrate monopoly and, together with du Pont's plant at Belle, West Virginia, is supplying our nitrate requirements for explosives and the vast needs of our agriculture as well.

40,000 New Jobs

Ever since the First World War, every experiment of the laboratories has added to the nation's economic power and self-sufficiency. The kind of research that resulted in rayon, nylon and other synthetic fibers also has created more than forty thousand new jobs in the chemical industry alone—new wealth and new skills that can be turned to the uses of defense.

Though we still import all our rubber, several chemical, oil and rubber companies have developed, under the stress of competition and the urge for private profit, such synthetics as Neoprene, Butyl, Perbunam, Thiokol and the so-called "Buna" types which can be put into mass production within two years.

The American Way Will Win

It is this reporter's report that our chemical industry, developed and built under our traditional American system of free enterprise, is, in a real sense, the most powerful "secret weapon" in the world; that it is operating "all out" on the principle of national defense, first, last and all the time; that it is operating with confidence, efficiency and *élan;* and that it has the brains, the skill and the power to perform its creative magic more potently than the regimented robot-scientists of any totalitarian regime on earth.

This is the third of a series of advertisements sponsored and paid for by* Johns-Manville *and designed to tell the American people how indispensable our basic industries are for National Defense.

— JOHNS-MANVILLE —

American practice as exemplified by the Standards of the American Society for Testing Materials and the procedures given in Technical Paper 8 of the U. S. Bureau of Mines, nevertheless the American fuel chemist will find much information of interest and value in the British methods.

AMERICAN GAS ASSOCIATION PROCEEDINGS. Published by American Gas Association, 420 Lexington Avenue, New York, N. Y. 803 pages. Price $3 to members, $7 to nonmembers.

THE USUAL printing of the 1940 Proceedings of the Annual Convention of the Association, this affords the only available record of much of the technical and other activity of the Committees and of the speakers at the Convention sessions. Any library maintaining a file of literature on fuels should include this and the other volumes of the series.

ATLAS OF NOMOGRAPHS FOR PHYSICAL CHEMISTRY. By *G. V. Vinogradov* and *A. I. Krasilschikov*. Published by The Government Publishing House of Technical-Theoretical Literature (USSR), available from "Tekhkniga," KOGIZ, Ribnyi Per. 2, Pom. 28, Moscow, USSR. Price 50 rubles.

Reviewed by *L. B. Pope* and *M. G. Callaham*

ACCORDING to the "Annotation" which accompanies this collection, it is the first attempt ever made in the world's literature to organize a systematic group of nomographs for the calculation of theoretical and practical problems in physical chemistry. And a truly amazing collection it is. Representing about eight year's work, the more than 200 nomographs range from the simplest to some of the most complex relationships of physical chemistry—from the conversion to 0 deg. C. of the reading of a barometer with brass scale to the calculation of speed of sedimentation of spherical particles of an aerosol by the action of gravity according to the Millikan-Kenningham formula.

While many of the equations represented are of limited or theoretical interest to chemical engineers, some could be readily applied to chemical engineering problems. A few which could conceivably find industrial applications include those calculating relative or absolute humidities of air, the Clapeyron formula for density or partial pressure (4 charts), temperature changes of air and diatomic gases during adiabatic change in volume or pressure, Knudsen's factor for gas flow through tubes and apertures, pressures of saturated vapors (9 charts), conversions of concentration of dissolved substances from one unit to another (4 charts), osmotic pressures, pH by measurement of e.m.f., viscosity of emulsions. The familiar names attached to many charts—Debeye, Stokes, Einstein, Helmholtz, Nernst and others—lend authority to the work.

Excellent draftsmanship character-

izes the nomographs which are printed on large unbound sheets approximately twice the size of this page. Accompanying each is the formula which it solves together with a small diagram of the sequence in which the various lines are to be used. (These practically eliminate the necessity for a reading knowledge of the Russian language for a complete comprehension of the charts and their use.) Unfortunately, the grade of paper on which they are printed is inferior so that it would probably be most satisfactory to make photostats of frequently used charts.

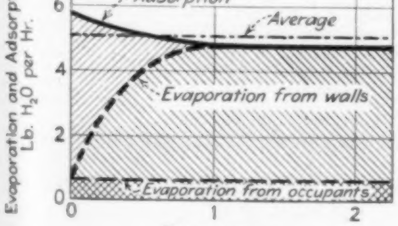
Ideas for some half-dozen nomographs have been borrowed from various authors. The others are of original construction. It is interesting to note that for nearly 20, new methods have been worked out. A booklet which accompanies the "Atlas" gives a bibliography, indexes and instructions.

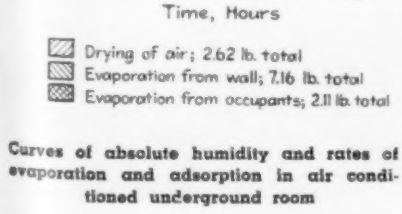
The authors express the hope that the "Atlas" will be useful and save time for a wide circle of readers. "It will no doubt be useful to physicochemists, but also to research workers in other fields, students of advanced chemistry, as well as engineers and laboratory workers." We agree.

CORRECTION

Mr. Edward Ledoux, author of "Conditioning Bombproof Underground Spaces for Shelters and Factories," (*Chem. & Met.* June 1941, p. 82) has pointed out that the editors misinterpreted the charts furnished to illustrate the article. Consequently the redrawing was erroneous and the cut (p. 83) should be disregarded.

The accompanying illustration gives the absolute humidity curve and the evaporation and adsorption curves as they should have been presented.





Drying of air; 2.62 lb. total
Evaporation from wall; 7.16 lb. total
Evaporation from occupants; 2.11 lb. total

Curves of absolute humidity and rates of evaporation and adsorption in air conditioned underground room

RECENT BOOKS and PAMPHLETS

Red Oxide of Iron. Published by Columbian Carbon Co., New York, N. Y. 116 Pages. Gratis, if requested on business letterhead. In two parts; Part I gives interesting details of the history of production and use of iron oxide pigments, includes directions for quantitative chemical analysis. Part II contains descriptions of colloidal structure, chemical and rubber compounding properties of Mapico 297, a new red oxide of iron.

Index and Summary of Present Status and Trends of Engineering Education in the United States. Compiled by *A. P. Johnson.* Published by the Engineers' Council for Professional Development, New York, N. Y. 31 pages. Price, with original report, $1. An index to the text and the tables and charts of the original report. Also includes a topical summary of the chapters dealing with the history and present status of engineering education in the United States.

Fatigue Tests of Welded Steel Joints in Structural Steel Plates. By *W. M. Wilson, W. H. Bruckner, J. V. Coombe* and *R. A. Wilde.* Bulletin No. 327 of the Engineering Experiment Station, University of Illinois, Urbana, Ill. 83 pages. Price $1. (Distributed gratis for a limited time.) A report of investigations conducted at the Station.

Lessons in Arc Welding. Second edition. Published by the Lincoln Electric Co., Cleveland, Ohio. 176 pages. Price 50 cents. Revised edition of a book which first appeared last year. (See *Chem. & Met.*, Oct. 1940, p. 720.) New material and illustrations have been added so that the book now contains 60 lessons giving practical information for beginners as well as for experienced operators.

Engineering Index. Vol. 56. Published by Engineering Index, Inc., New York, N. Y. 1410 pages. Contains 26,000 annotations and 40,000 cross-references to important articles that appeared in the American and foreign technical periodical literature. Every branch of engineering is covered. The book also contains an author and contributors index of approximately 19,000 names, and a list of the publications received.

The Cracking Art in 1939. By *Gustav Egloff*, Editor. Published as Booklet No. 244 by Universal Oil Products Co., Chicago, Ill. 617 pages. A thorough and detailed resume of progress during 1939 of refinery cracking from both research and commercial angles, including U. S. and foreign statistics; pyrolytic, catalytic and other cracking research; commercial cracking practice; special alloys, corrosion, and plant equipment; treating processes; chemical derivatives; commercial practice for high-octane fuel by polymerization and alkylation; extended abstracts or claims of 670 foreign and domestic patents classified according to type and country, supplemented by complete patentee and numerical patent indexes; and finally an extensive author index.

Petroleum Facts and Figures, 7th Edition (1941). Published by American Petroleum Institute, 50 West 50th St., New York City. 192 pages, 241 tables. Price $1. Seventh edition of this biennial statistical publication, covering 1939 and 1940. Gives valuable, complete and well-organized factual information from many sources on the petroleum industry, with emphasis on the domestic industry. Covers utilization, production, refining, transportation, marketing, prices and taxation, employment, and general information, and in many cases compares data for a number of years.

Labor in the Defense Crisis. By *T. R. Carskadon.* Published by the Public Affairs Committee, New York, N. Y. 31 pages. Price 10 cents. Summarizes a survey of the defense labor problem. Voluntary, not compulsory, arbitration is found to be the answer to industrial disputes.

Fire-Hazard Properties of Certain Flammable Liquids, Gases and Volatile Solids. Published by National Fire Protection Association. Boston, Mass. 48 pages. Price 25 cents. Revised edition of a table summarizing available data on fire hazard properties of some 400 flammable substances.

How Inventors Can Aid National Defense. Information Bulletin No. 2, National Inventors Council, U. S. Department of Commerce, Washington, D. C. 22 pages. Includes a description of types of inventions which may be found useful to defense agencies and suggested procedure for submitting inventions.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from Bureau responsible for its issue.

Materials in the National Bureau of Standards Soil-Corrosion Tests, by I. A. Denison. Bureau of Standards, Letter Circular LC-646; mimeographed.

Statistical Abstract of the United States, 1940. Bureau of the Census, unnumbered document, 925 pages, buckram bound; $1.50. A volume of statistical tables on a wide range of subjects. Many tables present figures from the earliest available data and are particularly valuable in the study of long-time trends. The 1940 Population Census totals for states and large cities are included.

Production of Electric Energy and Capacity of Generating Plants, 1940. Federal Power Commission, Publication FPC S-13; mimeographed. (Available from Federal Power Commission at 25 cents.)

Directory of State and Insular Health Authorities. Public Health Service, Reprint No. 2222; 5 cents.

Tables for Computing Oil Royalties Under the Leasing Act of February 25, 1920, as Amended by the Act of August 21, 1935. Geological Survey, unnumbered document; 10 cents.

Flood of August 1935 in the Muskingum River Basin, Ohio, by C. V. Youngquist, W. B. Langbein and others. Geological Survey, Water-Supply Paper 869; 40 cents.

Geology and Ore Deposits of Leadville Mining District, Colorado. Geological Survey, Professional Paper 148; $2.50.

Ground Water in Keith County, Nebraska, by L. K. Wenzel and others. Geological Survey, Water-Supply Paper 848; 70 cents.

Trends in the Consumption of Fibers in the United States, 1892-1939. Bureau of Agricultural Chemistry and Engineering, Southern Regional Research Laboratory, unnumbered document; mimeographed.

Wood Handbook, by R. F. Luxford, George W. Trayer and others. Department of Agriculture, Forest Products Laboratory, unnumbered document, Revised June, 1940; 35 cents. Basic information on wood as a material of construction with data for its use in design and specifications.

Chemical Composition of Sugarcane Juice as Affected by Fertilizers, by Nelson McKaig, Jr., and Louis A. Hurst. Department of Agriculture, Technical Bulletin 754; 10 cents.

Peat Resources in Alaska, by A. P. Dachnowski-Stokes. Department of Agriculture, Technical Bulletin 769; 15 cents.

Experiments in the Use of Vapor-Spray Equipment, by O. K. Hedden and R. M. Merrill. Department of Agriculture, Circular 598; 5 cents.

Drying of Wood. Forest Products Laboratory has issued the following mimeographed reports recently. Some relate to earlier studies and carry dates of late 1940, but all are only recently available for distribution on request direct to the Forest Products Laboratory, Madison, Wisconsin: Technique of Developing a Drying Process for

Small Stock, by O. W. Torgeson, R1263; Simplifying the Calculation of the Quantity of Air Required in Kiln Drying Lumber, by O. W. Torgeson, R1266; Function and Calculation of Ventilation in Drying Compartments, by O. W. Torgeson, R1265; The Drying Rate of Sugar Maple as Affected by Relative Humidity and Air Velocity, by O. W. Torgeson, R1264; Why the Drying Time of a Kiln Load of Lumber is Affected by Air Velocity, by O. W. Torgeson, R1269.

Survey of American Listed Corporations—Reported information on selected defense industries: Construction, Mining and Related Machinery; Metal Working Machinery; General Industrial Machinery; Engines and Turbines; Iron and Steel. Securities and Exchange Commission, Volume VI, Reports 43-47 Inclusive. Available from Securities and Exchange Commission, Washington, D. C.

Laws, Regulations, Decisions of Courts, Opinions of Attorney General. Government Printing Office, Price List 10, 32nd Edition.

Visual Information on Problems of the Wage Earner. Department of Labor, unnumbered document; 10 cents. A guide to exhibits, motion pictures, slides, posters, and charts available from the U. S. Department of Labor.

Handbook of Federal Labor Legislation—Part I, Labor Standards on Government Contract Work and Work Financed by the United States. Division of Labor Standards, Bulletin No. 39, Part I; 35 cents.

Italian Commercial Policy and Foreign Trade, 1922-1940. U. S. Tariff Commission Report No. 142; Second Series; 30 cents.

Rules of Practice Before the United States Board of Tax Appeals. Board of Tax Appeals, unnumbered document: 10 cents, Revised to April 1, 1941.

Land Classification in the United States. National Resources Planning Board, unnumbered document; 60 cents.

Federal Aids to Local Planning. National Resources Planning Board, unnumbered document; 30 cents.

Ferromagnetic Properties of Hematite, by Earl T. Hayes. Bureau of Mines, Report of Investigations 3570; mimeographed.

Limestone and Dolomite in the Chemical and Processing Industries, by Oliver Bowles and Mabel S. Jensen. Bureau of Mines, Information Circular 7169; mimeographed.

Ignition Temperatures of Acetylene-Air and Acetylene-Oxygen Mixtures, by G. W. Jones and W. E. Miller. Bureau of Mines, Report of Investigations 3567; mimeographed.

Ore-Testing Studies, 1939-40, by A. L. Engel and S. M. Shelton. Bureau of Mines, Report of Investigations 3564; mimeographed.

Exploration and Sampling of Domestic Deposits of Strategic Minerals by the Mining Division, Bureau of Mines. Report of Progress as of May 1, 1941, by Mining Division Staff. Bureau of Mines, Report of Investigations 3574; mimeographed.

Sulfur and Pyrites, by Robert H. Ridgway and others. Bureau of Mines, Preprint from Minerals Yearbook, 1941; 5 cents.

Lead and Zinc Pigments and Zinc Salts, by H. M. Meyer and A. W. Mitchell. Bureau of Mines, Preprint from Minerals Yearbook, 1941; 5 cents.

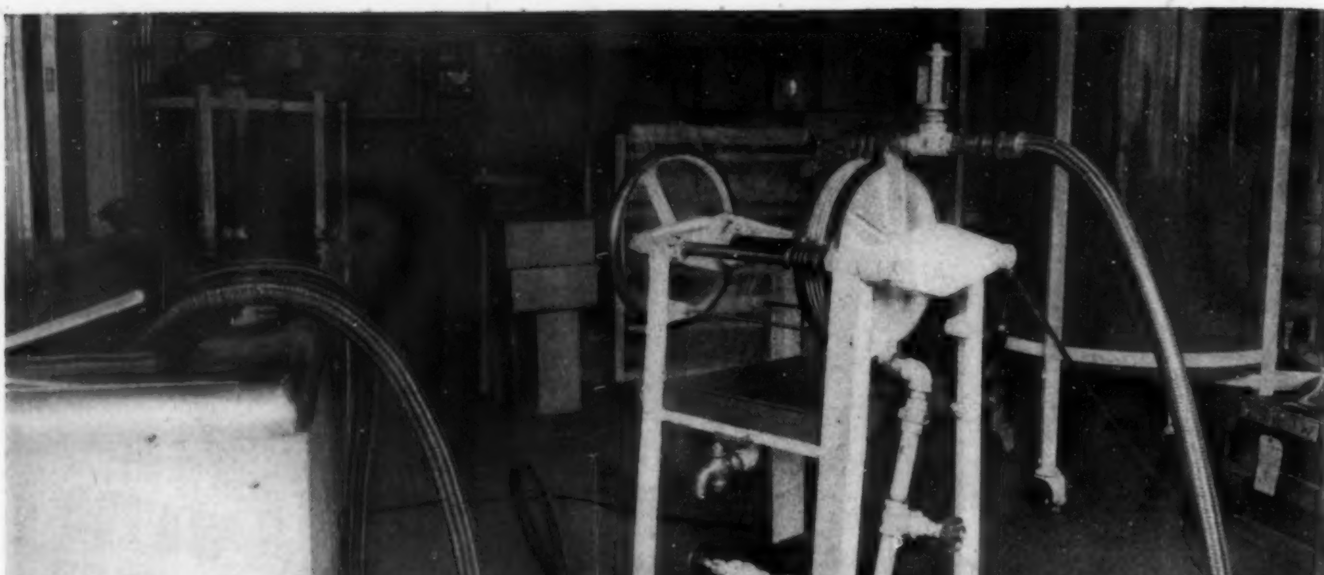
Magnesium, by Herbert A. Franke and M. E. Trought. Bureau of Mines, Preprint from Minerals Yearbook, 1941; 5 cents.

Statistical Trends of the Pennsylvania Anthracite Industry, 1936-40. Bureau of Mines, Weekly Anthracite-Beehive Coke Report No. 206, Supplement; mimeographed.

Barricading as a Life-Saving Measure in Connection With Mine Fires and Explosions, by D. Harrington and W. J. Fene. Bureau of Mines, Miners' Circular 42; 10 cents.

Phenolic Disinfectant (Emulsifying Type); Phenolic Disinfectant (Soluble Type). Bureau of Standards, Commercial Standards 70-41 and 71-41 (Second Edition); 5 cents.

Salt Packages. Bureau of Standards, Simplified Practice Recommendation R70-41; 5 cents.



The toughest tubing you can buy

Helps make precious perfumes!

HERE American Seamless, industry's "work-horse" flexible tubing, plays a dual role in conveying essential oils, alcohol and precious perfumes to and from portable filter without contaminating the carefully created scents. It's rugged enough to take the beating of constant flexing and abrasive contact with a concrete floor, yet the special bronze of which it is made is kind to madam's delicate fragrances.

American Seamless Flexible Metal Tubing has no welds, laps, seams or packing of any kind. It's made from *seamless* tube, reinforced with one or more wire braids. Result: strong as pipe and flexible as garden hose.

Available in various metals

This super tubing is made in several metals and alloys which adapt it for economical use with acids, alkalis and organic chemicals. If there is a place in your plant where penetrative gases or liquids must be conveyed either by suction or under pressure, find out more about American Seamless. A letter will bring you complete engineering data along with Bulletin No. 40, a 16-page book of facts.

41260

ANACONDA

American Metal Hose

American Metal Hose Branch of THE AMERICAN BRASS CO., General Offices: Waterbury, Conn.
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont. • *Subsidiary of Anaconda Copper Mining Co.*

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Aluminum. Aluminum Co. of America, Pittsburgh, Pa.—56-page bound booklet entitled "Forming Aluminum" with engineering data on available aluminum alloys and operations such as blanking and piercing, drawing, spinning, embossing, coining and stamping. Gives useful data charts, schematic drawings, and close-up photographs of various operations. Also 104-page booklet containing basic information on use of aluminum in aircraft. Describes, illustrates and gives engineering data on use of aluminum for this purpose; also includes a large number of tables with information on mechanical properties of various alloys, commercial tolerances, and standards for wire, rod, bar, and tubing sizes.

Bearings. Keystone Carbon Co., Inc., 1935 State St., St. Marys, Pa.—24-page booklet describing the properties and uses of this concern's self-lubricating bearings, with chart on allowances for press fit into housing and running fit after installation. Contains detailed information on dimensions of various types and sizes as well as details on correct method of installation.

Bearings. New Departure Div., General Motors Sales Corp., Bristol, Conn. —15th edition of this concern's handbook listing the principal types and sizes of forged-steel ball bearings, with 154 pages of engineering information on dimensions, load ratings, bearing fits, list prices, and equivalent tables. A new finger index makes quick reference possible.

Belting. The B. F. Goodrich Co., Akron, Ohio—Catalog Section 2140—2-page sheet on this concern's line of "Multicord" belting which discusses construction and advantages, and gives tables of minimum pulley diameters and approximate weights of various widths of belting.

Blowers. Roots-Connersville Blower Corp., Connersville, Ind.—Form 102—6-page folder discussing and illustrating this concern's blowers and gas pumps for use with oil and gas-fired furnaces, ovens, heating systems, and similar equipment.

Carburizing. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.—Catalog T623—25-page illustrated catalog dealing with the "Homocarb" method for carburizing. Illustrations show furnaces in action, and diagrams, charts and photomicrographs demonstrate principles and advantages of this concern's method of heat-treating.

Carburizing. The Lithium Corp., Raymond-Commerce Bldg., Newark, N. J.—4-page folder discussing briefly and illustrating this concern's "Lithcarb" atmosphere furnaces for bright, carburizing steels.

Chemicals. Hercules Powder Co., Synthetics Dept., Wilmington, Del.—8-page bulletin entitled "Some Effects of Abalyn and Hercolyn on the Properties of Blown Asphalt." Contains tables on the fluidity of asphalt, its rate of penetration to asbestos and felt, and changes in viscosity, flexibility, impact resistance, etc., brought about by addition of these liquid esters of abietic acid.

Chemicals. Heresite & Chemical Co., Manitowoc, Wis.—18-page catalog on this concern's finishes and plastics for coating purposes. Gives photographic illustrations of installations using equipment lined by company's coating materials, discussion of range of applications, and information on other finishes, transparent molding compounds, plywood adhesives and resistant and decorative colored enamels.

Chemicals. The Quaker Oats Co., 141 W. Jackson Boulevard, Chicago, Ill. —1941 edition of this concern's booklet on the furans and other chemicals made from oat hulls. Includes information on physical constants, shipping weight and containers, grades, general properties, and detailed description of various industrial uses.

Chemical Porcelain. Lapp Insulator Co., Inc., Chemical Porcelain Div., LeRoy, N. Y.—Bulletins 196, 197 and 198—4, 8 and 4-page bulletins respectively on this concern's chemical porcelain. The first gives general description, including a table of characteristics, while the second deals with chemical porcelain valves, pipe, and fittings, and includes cross-sectional sketches, tables of dimensions, and other data. The last gives sizes and specifications and a general discussion of chemical porcelain Raschig rings.

Compressors. Quincy Compressor Co., Quincy, Ill.—A pocket size selector, functioning like a slide rule, designed to aid in selecting correct size and type of compressor for a specific job, with the scale showing correct compressor model number, free air delivery, r.p.m., piston displacement and motor horsepower required. Pressures covered by the selector range from 30–250 lb. Designed to simplify the work of engineers, purchasing agents and others selecting air compressors.

Compressors. The Trane Co., LaCrosse, Wis.—Bulletin S-399—24-page illustrated booklet on this concern's turbo-vacuum compressors of various types, with discussion of outstanding features and advantages, control arrangements, cycle of operation and various commercial installations as well as diagrammatic sketches of units. Also Bulletin DS-361, 16-page bulletin on the concern's reciprocating compressors which includes illustrations, brief discussion, diagrams of typical piping arrangements, and detailed engineering data on mechanical specifications, as well as dimensional drawings of various types.

Control. Rehtron Corp., 2159 Magnolia Ave., Chicago, Ill.—Bulletin 542—4-page folder announcing this concern's new photoelectric smoke indicator and combustion control robot, with discussion of general features and applications, illustrations and prices.

Cooling Coils. The Trane Co., LaCrosse, Wis.—Bulletin DS-365—68-page catalog of this concern's cooling coils of various types, with illustrations and brief descriptions of advantages, selection, uses in industry, as well as extensive engineering data on capacities, calculating performance, piping details, heat content of air, roughing-in dimensions, and a psychrometric chart.

Couplings. D. O. James Mfg. Co., 1120 W. Monroe St., Chicago, Ill.—Bulletin 33—8-page bulletin on this concern's flexible couplings of various sizes and types, including cross-sectional drawings, price lists, selection tables and other engineering data on the various units.

Electrical Equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Booklet 4004—8-pages on this concern's direct-current motors for service in mines, mills and general industry, with discussion of sealed-sleeve bearings, directed ventilation and other recent improvements. Also catalog section 26-210, 4-page folder on welding circuit control panels with basic ratings up to 300 amp. for constant potential multiple operator welding systems, with descriptions of inclosure type and general panel construction, panel current ratings, circuit controls, and other information. Also Pamphlet 33-216, 8-page bulletin on this concern's oil circuit breakers for indoor service, with details on operation, construction features and illustrations.

Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis — Leaflet B-6169 — 4-pages on this company's new compact vertical motor-driven hammer mill for grinding chemical and mineral products,

byproducts of cereal mills, etc. Includes dimension details, sectional and installation views. Also Bulletin B-6166, 8-page folder on crushing, grinding, screening and mining equipment and how to cut operating costs with such equipment. Includes illustrations and brief descriptions of the company's line of such machinery, including centrifugal pumps, blowers, compressors, and related power and electrical equipment.

Equipment. The American Brake Shoe & Foundry Co., American Manganese Steel Div., Chicago Heights, Ill. —Bulletin 641-S—8-pages on this concern's power shovel and dragline parts which illustrates each unit. Also 641-D, 24-page bulletin illustrating and discussing briefly the concern's power shovel dippers and dipper parts.

Equipment. The Carlyle Johnson Machine Co., Manchester, Conn.—Series No. 2—12-sheet folder on this concern's new floating plate multiple-disk clutches of single and double types. Sheets give engineering drawings of each size of clutch, with data on capacities and other features.

Equipment. Carrier Corp., South Geddes St., Syracuse, N. Y.—Form AC-146—16-page catalog on this concern's air conditioning, refrigeration and unit heating equipment for industrial use. Includes photographs, brief descriptions and selection charts for temperature and humidity control equipment as well as refrigeration and heating equipment.

Equipment. Centrifugal & Mechanical Industries, Inc., 2nd and President Sts., St. Louis, Mo.—8-page catalog on this concern's continuous centrifugal dryers and clarifiers, with illustrations of installations and operating principles and brief discussion of design and construction as well as capacities and power requirements.

Equipment. Combustion Engineering Co., Inc., 200 Madison Ave., New York, N. Y.—Catalog SS2—12-page pamphlet describing design features of this concern's spreader stoker, containing illustrations of assemblies and typical installations, together with close-up views of the feeder and auxiliary mechanisms. Drawings show applications of this method of firing to various types of boilers and range of fuels that can be burned is discussed.

Equipment. The Patterson-Kelley Co., Inc., East Stroudsburg, Pa. — 8-page pamphlet on this concern's chemical and process equipment, including autoclaves, condensers, converters, evaporators, heat exchangers, tanks, etc. Each unit is illustrated by photograph and briefly described.

Equipment. H. K. Porter Co., Inc., Process Equipment Division, 4914 Harrison St., Pittsburgh, Pa.—Catalog 101 —28-page bulletin on this concern's agitators, blenders, mixers, digesters, kettles, ball mills and pebble mills for process industries, including photographic and drawing illustrations, brief descriptions and engineering data and tables for each type.

Equipment. W. A. Russell & Co., Bridgeport, Conn.—4-page bulletin on this concern's automatic humidification unit called the "Moisturator" to provide controlled evaporation and distribution of humidity. Sketches show operating principles.

Evaporators. Swenson Evaporator Co., Harvey, Ill.—Bulletin E-100—8-pages on this concern's long-tube vertical evaporators, accompanied by flow sheets illustrating uses in various industries, description of applications, construction and principal features, and diagrammatic illustration of a backward feed 6-body quintuple effect evaporator with condensate and liquor flash systems.

Equipment. The Trane Co., LaCrosse, Wis.—Bulletin S-260—36-pages on this concern's heating specialties including traps, valves, gages, regulators, and other specialties of various types for steam, vapor or vacuum heating equipment. Includes extensive engineering data on typical piping connections, valve sizes and dimensions, as well as roughing-in dimensions for various valves and traps.

Equipment. Traylor Engineering & Mfg. Co., Allentown, Pa.—Bulletin 115

—22-page bulletin on this concern's kilns, coolers and dryers, with photographs of actual installations and brief discussions of features and uses.

Fire Clays. Illinois Clay Products Co., Joliet, Ill.—4-page pamphlet on this concern's fire clays of various types, with brief discussion of principal uses for lining, patching and luting, laying firebrick, and other purposes. Includes information on the concern's bond clay for bonding foundry sands.

Flash Drying. Raymond Pulverizer Div., Combustion Engineering Co., Inc., 1324 Long Branch St., Chicago, Ill.—Bulletin No. 50—4-page folder illustrating and discussing briefly this concern's flash drying system for the production of powdered materials such as synthetic resins, manganese sulphate, bentonite clay, acid-treated clay, and other products.

Furnaces. The Drever Co., 748 E. Venango St., Philadelphia, Pa.—Bulletin B-3—4-page folder on this concern's industrial furnaces, with photographs illustrating installations for annealing, clean hardening and general purposes, together with brief descriptive material.

Gears. Synthane Corp., Oaks, Pa.—Folder on this concern's silent stabilized gear materials, describing the principal properties of "Synthane" grades most used for gears together with chart of various engineering information on gears of 2 to 18 pitch, and from 12 to 60 teeth.

Hose. The B. F. Goodrich Co., Akron, Ohio.—Catalog Section 4030—4-page folder on high-pressure hydraulic control hose marketed by this concern. Describes functions of this hose, uses, description of manufacturing features, sizes, couplings and adapter unions, and method of figuring correct bending radii for various sizes of hydraulic control hose.

Instruments. Boulin Instrument Corp., 65 Madison Ave., New York, N. Y.—4-page folder on this concern's centrifugal tachometers of the single range hand, stationary and triple-range centrifugal types. Includes brief discussion, illustration, principal features and specifications of each type.

Instruments. The Brown Instrument Co., Philadelphia, Pa.—182-page book on instrumentation and automatic control in the oil refining industry, including useful engineering data in the form of illustrations, diagrams and drawings, text material, charts and tables. Includes valuable material on temperature, pressure, flow, and liquid level measurements, principles and applications of automatic control in oil refining, control valves, and other information.

Instruments. The Brown Instrument Co., Philadelphia, Pa.—Bulletin 8914—bulletin on control accessories for pneumatic controllers, giving descriptions and dimension tables, diagrams and sizing charts for valves, diaphragm motors, pressure regulators, and other accessories. Also Bulletin 2933 dealing with this concern's system of desuperheater control. Covers operating characteristics of the system, application data, and forms available, including schematic diagrams. Also bulletin 48-1, entitled "Brown Carbonated Beverage Control System," with description of control instruments for bottling plants and carbonated beverage manufacture.

Instruments. The Cochrane Corporation, 17th and Allegheny Ave., Philadelphia, Pa.—Publication 3020—4-page folder on this concern's steam sample degasifier for condensing a steam sample, separating non-condensible gases for analysis, and degasifying the condensed sample for conductivity tests for determination of carry-over. Bulletin includes brief discussion of principles, mode of operation, and advantages of the degasifier, together with illustrations of principal features.

Insulation. Union Asbestos and Rubber Co., 1821 S. 54th St., Cicero, Ill.—Form 48-965—4-pages on this concern's asbestos-base blocks, sheets and sectional pipe covering for heat insulation, including illustrations and discussion of applications and outstanding features, sizes and list prices, as well as engineering data on thickness to use.

Chem & Met ECONOMICS and MARKETS

CURTAILMENT OF RAW MATERIAL SUPPLIES CUTS DOWN INDUSTRIAL CONSUMPTION OF CHEMICALS

Apparently industrial consumption of chemicals has passed its peak as direct defense requirements demand a greater part of available raw materials. For a long time it has been evident that an accelerated general industry plus an abnormal war-industry would create a demand for materials which could not be met. War-industry work has reached a point where more and more raw materials are being transferred from the accustomed channels to needs which are more pressing. In addition to the exercise of priority controls, several industries are adversely affected by orders limiting their activities and these limitations will be accentuated in later months. So far as chemicals are concerned this is resulting, not in a drop in total consumption but in the shifting of activities from one type of manufacture to another. Hence an index for consumption must be viewed in that light and, while present conditions continue, allowance must be made for the vast new consuming industry which has come into being and which promises to push both chemical production and consumption to heights hitherto unreached.

Chem. & Met's Weighted Index For Chemical Consumption

	May revised	June
Fertilizer	33.12	30.96
Pulp and paper	22.90	23.00
Petroleum refining	15.34	15.10
Glass	15.90	15.55
Paint and varnish	18.96	17.64
Iron and steel	13.35	13.04
Rayon	12.30	11.94
Textiles	11.15	10.64
Coal products	9.18	9.16
Leather	4.85	4.72
Explosives	5.53	5.76
Rubber	4.12	4.69
Plastics	3.75	3.60
	170.45	166.10

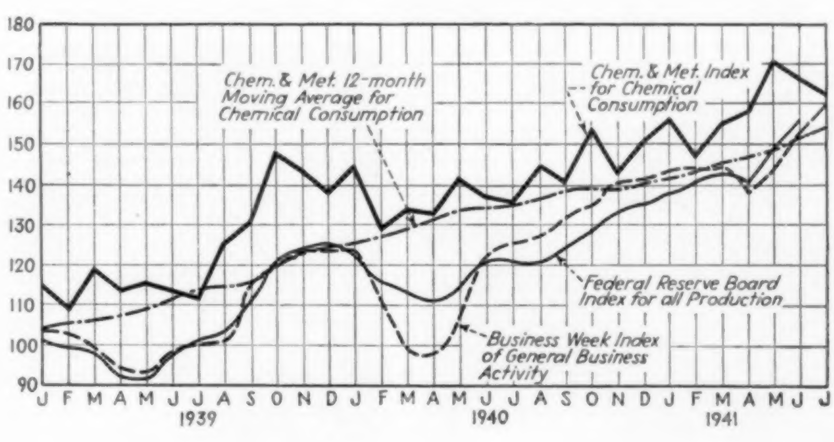
Based on the data at hand, industry consumption of chemicals in the last two months was on a declining scale. The preliminary index for July is 162 and for June 166.10. The index number for May has been revised upwards due to the unexpectedly high output at fertilizer plants in that month. The revised index of 170.45 for May was higher than had ever before been reached. Index numbers for May, June, and July of last year were 141.35, 137.86, and 136.57 respectively.

The Bureau of the Census has issued a report on production and consumption of vegetable oils for the second quarter of the year. Production reached a total of 1,400,868 thousand pounds compared with 1,022,576 thousand pounds for corresponding quarter of last year. Consumption amounted to 1,694,415 thousand pounds as against 1,250,524 thousand pounds in the 1940 quarter. These totals contain some duplications as the totals for production of some of the refined oils are included in the figures for crude. However, this duplication also is found in the 1940 figures and the tabulations show that the vegetable oil trade has been more active than that reported for chemicals.

Reverting to the chemical-consuming industries, it is noted that output of automobiles will be reduced over the remainder of the year and as a wide variety of chemicals, directly or indirectly, go into automotive manufacture, it is evident that the cut in production will be felt in the market for chemicals. Pulp mills are working on basis of reducing chlorine consumption by 15 percent which means a loss in chlorine trade in that direction. Silk production will be along specified lines which are expected to limit the use of chemicals in their fabrication. Rubber mills will go on schedules calling for a marked drop in amounts of rubber consumed. These are among the recent developments which are affecting the use of chemicals in industry and which warrant the belief that industry consumption has passed its peak.

Indicative of the enlarged demand for chemicals which is coming from direct government requirements is the record output of 32,223,500 proof gallons of ethyl alcohol reported for June and it also is noted that stocks at producing points advanced only slightly during that month so it is fair to assume that production and consumption are closely in line. Incidentally, it is reported that steps are being taken to make greater use of distillery capacity in order to increase the output of alcohol so that this material may be able to take care of more than its usual share of next seasons anti-freeze requirements.

The Department of Commerce has issued revised figures for woodpulp production for the first four months of this year. The revised totals reduce the amount produced by 68,058 tons.

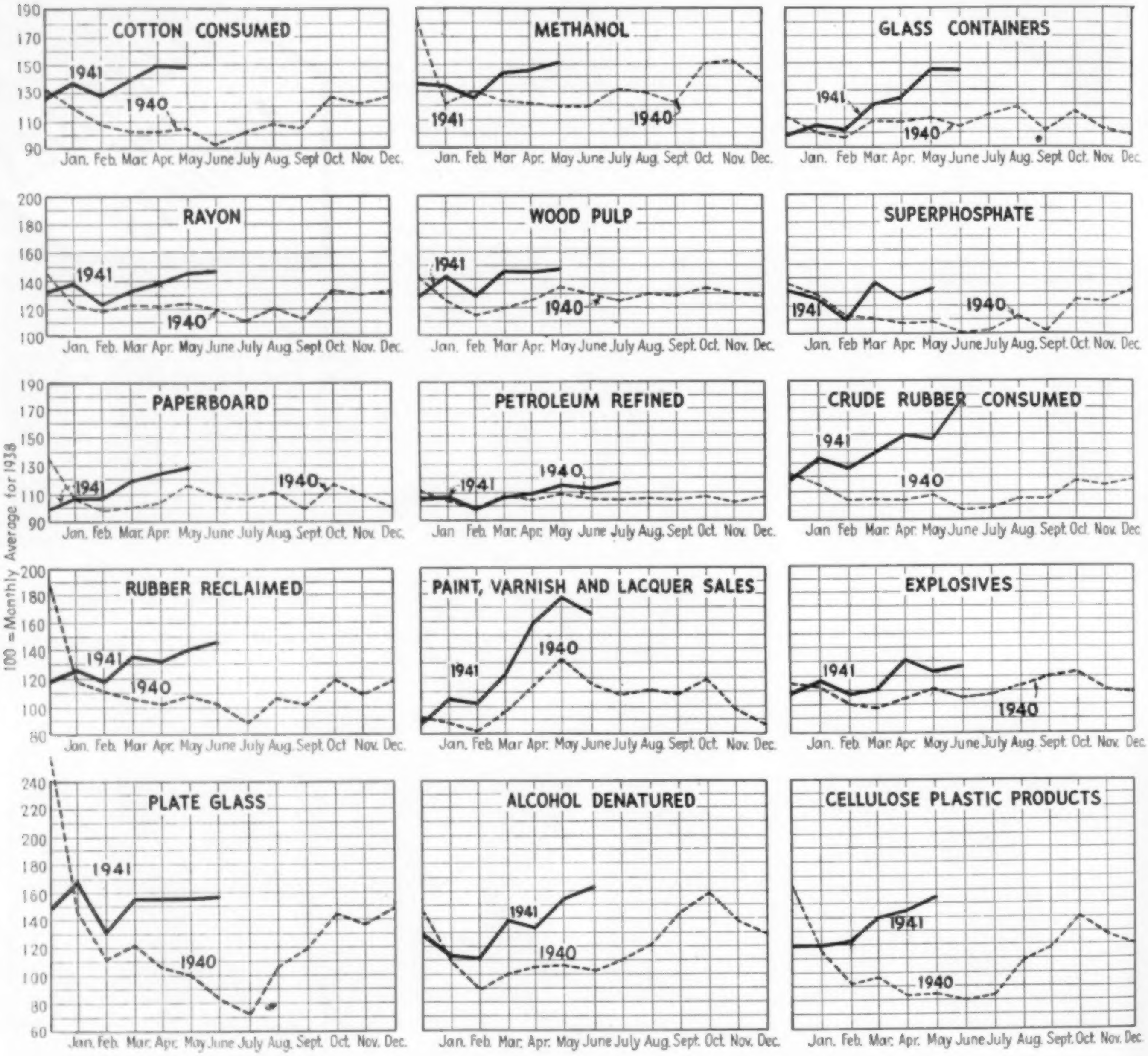


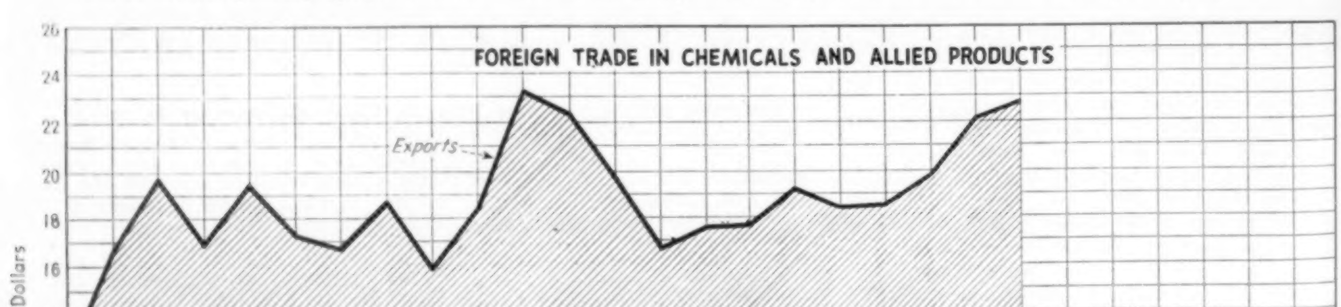
Production and Consumption Data for Chemical-Consuming Industries

Production	June 1941	June 1940	January-June 1941	January-June 1940	Percent of gain for 1941
Alcohol ethyl, 1,000 pr. gal	32,224	21,422	159,527	124,605	28.0
Alcohol, denatured, 1 000 wi. gal	15,387	9,706	77,113	58,120	32.7
Ammonia liquor, 1,000 lb.[1]	5,405	4,404	31,418	27,109	15.9
Ammonium sulphate, tons [1]	61,492	58,514	368,355	341,201	10.8
Benzol, 1,000 gal.[1]	11,563	11,052	73,498	62,216	18.1
Toluol, 1,000 gal.[1]	2,462	....	13,977	....	....
Naphthalene, 1,000 lb.[1]	7,397	....	40,344	....	....
Byproduct coke, 1,000 tons	4,836	4,387	28,591	25,525	12.0
Glass containers, 1,000 gr	6,166	4,429	31,747	26,706	18.9
Plate glass, 1,000 sq. ft	18,524	9,783	108,543	78,605	38.1
Window glass, 1,000 boxes	1,304	908	8,361	6,618	26.3
Rubber reclaimed, tons	23,790	16,581	130,064	104,957	24.0
Consumption					
Cotton, bales	875,137	565,416	5,205,260	3,850,908	35.2
Silk bales	24,251	17,307	152,593	131,720	15.8
Wool 1,000 lb	53,076	25,171	303,209	167,676	80.8
Explosives, 1,000 lb	39,460	32,877	214,770	195,470	9.9
Paint, varnish and lacquer, $1,000	54,336	37,898	273,194	205,554	32.9
Rubber, crude, tons	84,912	47,834	425,178	317,301	34.0
Rubber, reclaimed, tons	22,559	15,163	121,858	95,890	27.1

[1] Byproduct coke production.

Production and Consumption Trends





"BAKELITE" RESIN COATINGS APPLIED BY

SPECIAL BAKING TECHNIC IN YOUR OWN PLANT

Provide Durable, Protective Linings for Tanks, Drums, Containers

ARE YOU confronted with the problem of safeguarding the contents of your containers, tanks, and other equipment from contamination or discoloration? Are you experiencing difficulty in obtaining platings formerly used to protect container interiors? To both of these problems a low-cost solution may now be found in heat-reactive coatings, based on BAKELITE Resins.

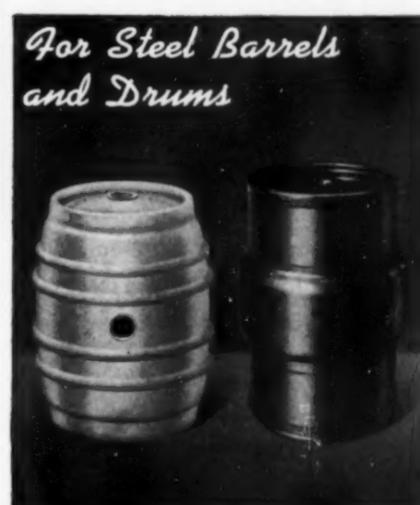
Baked rapidly to a tenacious glass-like finish, these durable coatings are providing effective protection in the processing, storing, packaging, and shipping of foodstuffs, beverages, cosmetics, chemicals, drugs, soaps, oils, solvents . . . products of every description. These coatings are baked by means of special portable baking equipment which is brought directly to the job. Your own equipment does not have to be dismantled nor shipped out of the plant. Also, this new baking technic can be applied to areas previously considered inaccessible.

Whatever your surface protection problems may be—whether they concern pails, drums, barrels, tanks, or other equipment—investigate these new heat-reactive coatings formulated with BAKELITE Resins. Our laboratories will be glad to make specific recommendations and to give you the names of paint and varnish manufacturers equipped to provide and apply these exceptionally durable finishes.

Virtually any product shipped in pails or cans, in pint or gallon sizes, may obtain the added protection of BAKELITE Resin coatings. These baking-type finishes not only are highly resistant to water and most chemicals, but provide the flexibility, toughness, and wear resistance required to meet the hard knocks encountered in shipping and in service. These coatings eliminate metal platings, thereby releasing tin and zinc for vital defense needs.

Tank car interiors are now protected with corrosion-resistant BAKELITE Resin finishes which provide smooth, glass-like linings. The coatings are applied right in the yard and dried rapidly by special portable baking equipment. Cars in service for several years demonstrate the resistance of these coatings to constant cleaning with live steam.

Storage tanks for edible products, such as beer, wine, glucose, and milk, give greater service and protect the purity of their contents longer when lined with heat-reactive BAKELITE Resin coatings. The coatings may be similarly applied on metal tanks and vats employed in water purification systems and chemical processing.



Typical examples are the thousands of steel beer barrels which are now lined with heat-reactive coatings formulated with BAKELITE Resins. These barrels have been in continuous service since 1938 and the linings are still in perfect condition. Tough and tenacious, these linings withstand constant scouring at the brewery and the severe shocks to which the barrels are subjected in transit and delivery.

BAKELITE CORPORATION, 30 EAST 42ND STREET, NEW YORK, N.Y.

Unit of Union Carbide and Carbon Corporation

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BAKELITE

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RESINS FOR PROTECTIVE COATINGS

DELIVERIES OF CHEMICALS TAKE UP ENTIRE OUTPUT WITH NO SURPLUS STOCKS

THERE has been no material change in the market for chemicals in the last month nor does there promise to be any modification of the existing situation. Production is moving away from plants as fast as it is turned out and no opportunity is given for building up reserves. In many cases, supplies are being allotted so as not to discriminate among consumers and as the amounts allotted are expected to decrease in volume, consumers are faced with the problem of curtailing operations, of finding substitute materials, or of turning over part of their plant capacities to other types of work to which the equipment is adapted.

Small amounts of chemicals still find there way into the resale market and command fancy prices but total volume of such sales accounts for a very minor part of total chemical output. For instance, reports have been heard regarding high prices paid for formaldehyde and it is found that some of the sales involved a single drum. The general price tone of the market, however, has been strong for some months and the average level of values has been slowly rising with some acceleration noted in recent trading. Spirits of turpentine scored a noteworthy advance in price in the last month and as other solvents have been very firm for some time, the entire solvent division is now in unison. Deliveries of vanillin have been slow because of the preponderance of demand but production capacity is being extended. Prices have been revised and individual shipments of 1,000 lb. or over on contracts of 5,000 lb. are now offered at $2.15 per lb. The quotations range upwards to $2.55 per lb. on a quantity basis. Because of heavy weevil infestation, call for calcium arsenate has been heavy and with production costs higher, revised sales schedules have gone into effect for the arsenate. Lead arsenate likewise has been moved up in price. Another advance came with the announcement that nitrate of soda prices had been advanced. A factor which has a bearing on prices consists in the method of quoting some chemicals on a basis of shipping point and where these chemicals were shipped by water and now must be moved by rail there is an addition to the cost delivered at consumers plants.

Vegetable oils which received a temporary setback when price ceilings were first mentioned, have shown a rather general price advance in the last month and unless cottonseed oil is regulated there is nothing in sight to change the price position as demand for the oils is active and consumption figures reveal that price advances may be accounted for on a supply and demand footing. Linseed oil has been marking time with values expected to move in accord with reports about the progress of the growing seed crop.

Increased call for plastic materials is reflected in increased production and official figures place the output of cellulose acetate molding composition at 12,773,464 lb. for the first half of this year compared with 5,967,248 lb. in the corresponding period of last year. Nitrocellulose products also show a gain in output with the six months totals being 7,784,841 lb. and 5,766,970 lb. respectively, the figures including sheets, rods, and tubes.

While export trade in chemicals is restricted by the availability of shipping space and of materials, the official figures for outward shipments prove that there has been little if any decline in the movement of goods out of the country. The larger deliveries appear to be well distributed over the different divisions with industrial chemicals and chemical specialties carrying a little more than a proportionate part of the increase.

Withdrawal of coastwise shipping for use in overseas service has brought at least temporary reductions in all-rail freight rates on crude sulphur from Louisiana and Texas to the east. The new tariffs are reduced by 13.5 percent of the first class rate, with a rate of 55c. from the mines to New England as a maximum. This means actual reductions run as high as 30 percent. The new tariff carries a minimum of $100,000 lb. instead of the old 80,000 lb. minimum. As presently setup the reduced rates bear a Dec. 31, 1941 expiration date. It has been agreed, however, that the emergency rates will continue on 30 days notice after that date, if coastal shipping facilities have not been restored to their usual routes.

Although production has been resumed at the western plant which had been closed for more than three months because of labor troubles, the supply of borax is still below requirements and priority control over distribution of this commodity has been extended to Aug. 30. Boric acid also is included in the priority extension.

Chlorine was placed under full priority control on July 28 by action of OPM's Priorities Division. The order, however, does not require that all deliveries of the chemical must have a preference rating.

CHEM. & MET.

Weighted Index of

CHEMICAL PRICES

Base=100 for 1937

This month	**102.91**
Last month	101.17
August, 1940	98.63
August, 1939	96.96

Strength in solvents has been increased by higher prices for turpentine. Nitrate and phosphates of soda also are higher and some first hands are asking more for copper sulphate.

Producers are required to fill all defense orders ahead of other deliveries, and are required to accept all defense orders offered to them. After filling these orders, deliveries may be made to others so long as supplies last. Defense orders without a specific rating are automatically given an A-10 classification, and it is expected this rating will be applied to certain essential civilian uses such as needs for water supply treatment, etc.

In applying priorities, OPM reported that it believed defense orders would not increase materially in the near future. Present production is estimated at more than 700,000 tons annually, of which between 30 and 50 percent is believed going into defense orders.

Paper manufacturers, who already have agreed to a cut in their use of chlorine, are also affected by the high prices and the short supplies of casein. Domestic production of casein has been curtailed by the increasing demand for milk in liquid and powder form under the food-for-defense program and the Lend-Lease Act. The Soybean Research Laboratory at Urbanna, Ill., is studying the possibility of increased soybean protein. It is estimated that 10,000 tons of soybean protein will be required annually on the basis of current needs to make up for the shortage in casein. This is three to four times the amount now produced. Only one plant is now making refined soybean protein but two others are under consideration and one of these companies is operating a pilot plant.

Relaxation of the curtailment program on rubber to prevent hardship among small processors was announced late in July by OPM's Priorities Division. The new regulations permit 247 firms which consumed less than 10 tons of rubber in the base month of March, 1941, to ignore the stipulated cuts in operations during August. The cuts remain in effect for 144 processors using 90 percent of the total crude. A third group of 86 firms were granted special adjustments for August to permit them to handle defense orders.

The Army has added vitamin tablets to its daily rations for troops serving in far northern climates, such as Alaska. The tablets are a multiple compound of vitamins A, B1, B2, C and D as well as nictinic acid.

CHEM. & MET.

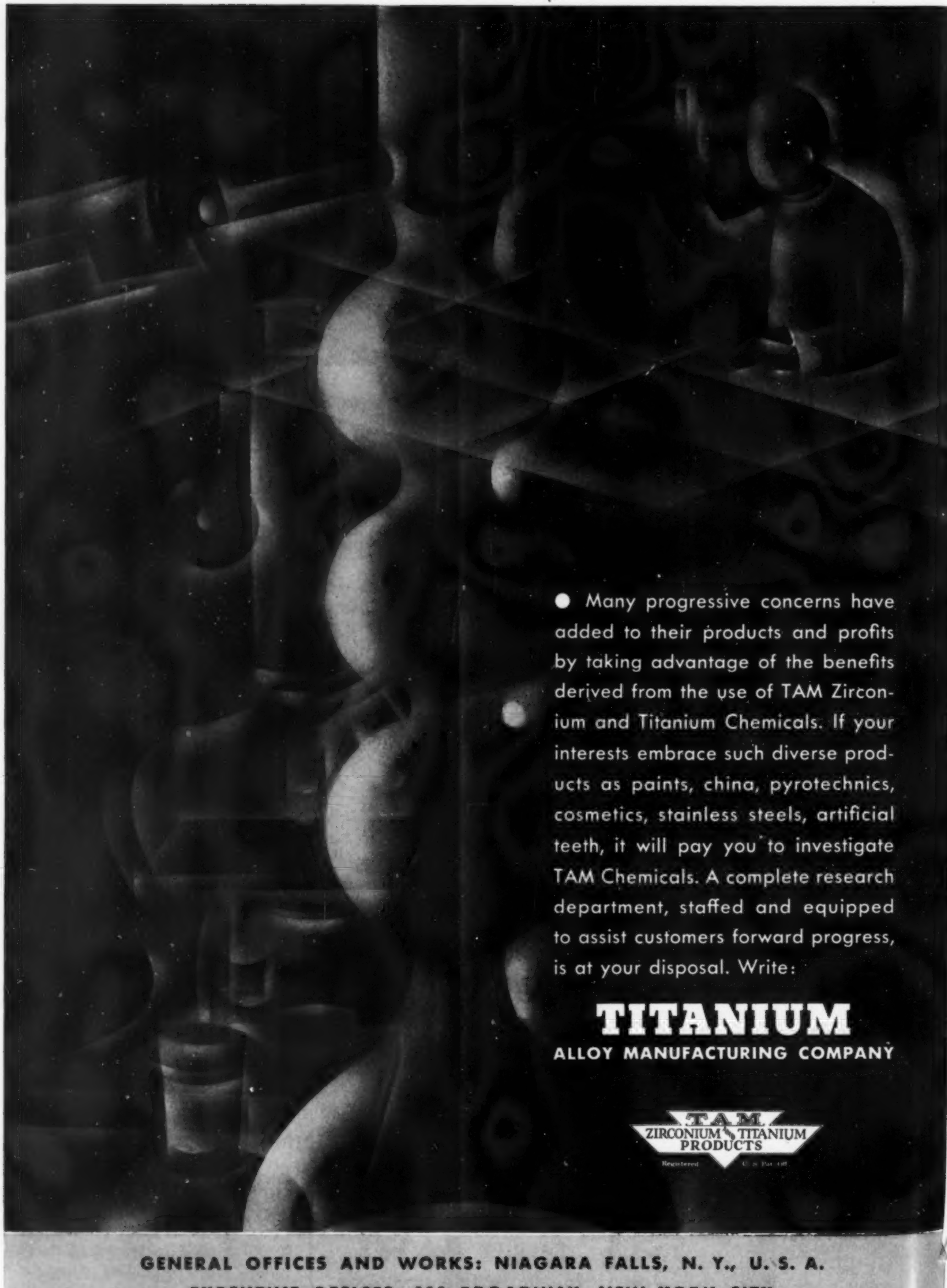
Weighted Index of Prices for

OILS & FATS

Base=100 for 1937

This month	122.80
Last month	119.58
August, 1940	68.24
August, 1939	66.80

Moderate price advances were almost general throughout the list of oils and fats. Future movements may depend largely on whether or not a ceiling is placed on cottonseed oil values.


● Many progressive concerns have added to their products and profits by taking advantage of the benefits derived from the use of TAM Zirconium and Titanium Chemicals. If your interests embrace such diverse products as paints, china, pyrotechnics, cosmetics, stainless steels, artificial teeth, it will pay you to investigate TAM Chemicals. A complete research department, staffed and equipped to assist customers forward progress, is at your disposal. Write:
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Representatives for the Pacific Coast States . . . . L. H. BUTCHER COMPANY, Los Angeles, San Francisco, Portland, Seattle
Representatives for Europe . . . UNION OXIDE & CHEMICAL CO., Ltd., Plantation House, Fenchurch St., London, E. C., Eng.

Chem & Met Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.08½–$0.09	$0.08½–$0.09	$0.07½–$0.08
Acid, acetic, 28%, bbl., cwt	3.18 – 3.43	2.23 – 2.48	2.23 – 2.48
Glacial 99.5%, drums	8.68 –10.00	8.68 –10.00	8.43 – 8.68
U. S. P. X1, 99.5%, dr.	10.50 –11.00	10.50 –11.00	10.25 –10.50
Boric, bbl., ton	106.00–111.00	106.00–111.00	106.00–111.00
Citric, kegs, lb	.20 – .23	.20 – .23	.20 – .23
Formic, cbys., lb	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	1.05 – 1.15	1.05 – 1.15	.90 – 1.00
Hydrofluoric 30% drums, lb	.08 – .08½	.08 – .08½	.08 – .08½
Lactic, 44%, tech., light, bbl., lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Muriatic, 18°, tanks, cwt	1.05 –......	1.05 –......	1.05 –......
Nitric, 36°, carboys, lb	.05 – .05¼	.05 – .05¼	.05 – .05¼
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –......	18.50 –20.00
Oxalic, crystals, bbl., lb	.10¾– .12	.10¾– .12	.10¾– .12
Phosphoric, tech., c'bys., lb	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –......	13.00 –......	13.00 –......
Sulphuric, 66°, tanks, ton	16.50 –......	16.50 –......	16.50 –......
Tannic, tech., bbl., lb	.64 – .66	.64 – .66	.54 – .56
Tartaric, powd., bbl., lb	.63 –......	.63 –......	.39¼–......
Tungstic, bbl., lb	nom.......	nom.......	nom.......
Alcohol, amyl	......–......	......–......	......–......
From Pentane, tanks, lb	.121–......	.121–......	.101–
Alcohol, Butyl, tanks, lb	.10 –......	.10 –......	.09 –......
Alcohol, Ethyl, 190 p'f., bbl., gal	6.04 –......	6.04 –......	5.98 –......
Denatured, 190 proof	......–......	......–......	......–......
No. 1 special, dr., gal. wks.	.33 –......	.33 –......	.29½–......
Alum, ammonia, lump, bbl., lb	.03¾– .04	.03½– .04	.03½– .04
Potash, lump, bbl., lb	.04 – .04½	.03¾– .04	.03¾– .04
Aluminum sulphate, com. bags, cwt	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt	1.85 – 2.10	1.85 – 2.10	1.60 – 1.70
Aqua ammonia, 26°, drums, lb	.02¼– .03	.02¼– .03	.02¼– .03
tanks, lb	.02 – .02¾	.02 – .02¾	.02 – .02¾
Ammonia, anhydrous, cyl., lb	.16 –......	.16 –......	.16 –......
tanks, lb	.04½–......	.04½–......	.04½–......
Ammonium carbonate, powd. tech., casks, lb	.09 – .12	.09 – .12	.09 – .12
Sulphate, wks., cwt	1.45 –......	1.45 –......	1.40 –......
Amylacetate tech., from pentane, tanks, lb	.115–......	.15 –......	.10½–......
Antimony Oxide, bbl., lb	.115–......	.12 –......	.12 –......
Arsenic, white, powd., bbl., lb	.04 – .04½	.03¾– .04	.03 – .03½
Red, powd., kegs, lb	nom.......	nom.......	.17 – .18
Barium carbonate, bbl., ton	55.00 –60.00	55.00 –60.00	52.50 –57.50
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb	.09½– .10	.09½– .10	.08½– .10
Blanc fixe, dry, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	43.00 –......	43.00 –......	43.00 –51.00
Bromine, cs., lb	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	3.00 –......	3.00 –......	1.90 –......
Arsenate, dr., lb	.07½– .07¾	.06½– .06¾	.06½– .06¾
Carbide drums, lb	.04¾– .05	.04¾– .05	.04¾– .05
Chloride, fused, dr., del., ton	19.00 –24.50	19.00 –24.50	19.00 –24.50
flake, dr., del., ton	20.50 –25.00	20.50 –25.00	20.50 –25.00
Phosphate, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb	.05 – .06	.05 – .06	.05 – .06
Tetrachloride drums, lb	.04¾– .05½	.04¾– .05½	.04¾– .05½
Chlorine, liquid, tanks, wks., lb	1.75 –......	1.75 –......	1.75 –......
Cylinders	.05¼– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb	1.84 – 1.87	1.84 – 1.87	1.84 – 1.87
Copperas, bgs., f.o.b. wks, ton	18.00 –19.00	18.00 –19.00	18.00 –19.00
Copper carbonate, bbl., lb	.18 – .20	.18 – .20½	.10 – .16
Sulphate, bbl., cwt	5.00 – 5.25	4.75 – 5.00	4.60 – 4.85
Cream of tartar, bbl., lb	.52 –......	.52 –......	.34¼–......
Diethylene glycol, dr., lb	.22 – .23	.22 – .23	.22 – .23
Epsom salt, dom., tech., bbl., cwt.	1.90 – 2.00	1.90 – 2.00	1.80 – 2.00
Ethyl acetate, drums, lb	.08½–......	.08½–......	.07 –......
Formaldehyde, 40%, bbl., lb	.05½– .06	.05½– .06¼	.05½– .06
Furfural, tanks, lb	.09 –......	.09 –......	.09 –......
Fusel oil, drums, lb	.17½– .19	.17½– .19	.16 – .17
Glaubers salt, bags, cwt	1.05 – 1.10	1.05 – 1.10	.95 – 1.00
Glycerine, c.p., drums, extra, lb.	.14½–......	.14½–......	.12½–......
Lead:			
White, basic carbonate, dry casks, lb	.07½–......	.07½–......	.07 –......
White, basic sulphate, sck., lb.	.07¼–......	.07¼–......	.06½–......
Red, dry, sck., lb	.0835......	.0835......	.07½–......
Lead acetate, white crys., bbl., lb.	.12 – .13	.12 – .13	.11 – .12
Lead arsenate, powd., bag, lb	.09½– .11	.09½– .11	.08½– .11
Lime, chem., bulk, ton	8.50 –......	8.50 –......	8.50 –......
Litharge, pwd., csk., lb	.0735......	.0735......	.06½–......
Lithopone, bags, lb	.0385– .04	.0385– .04	.036– .04
Magnesium carb., tech., bags, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½

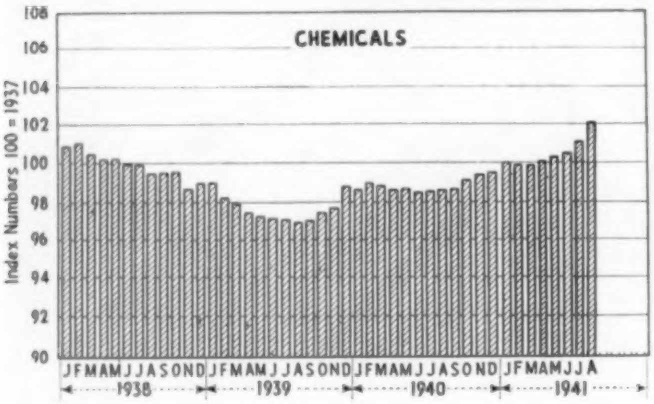
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to August 13

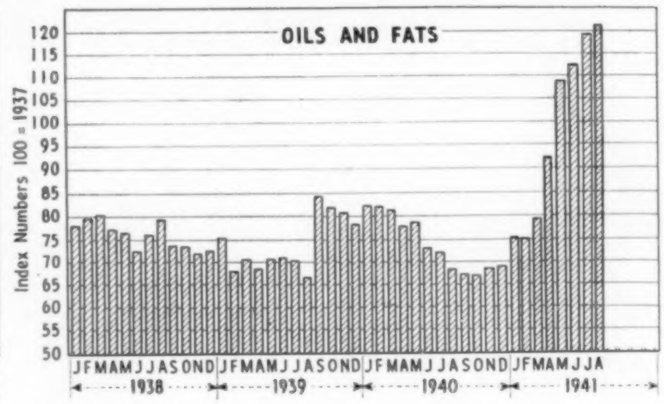
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.73 –......	.73 –......	.29 –......
97%, tanks, gal	.75 –......	.75 –......	.30 –......
Synthetic, tanks, gal	.30 –......	.30 –......	.30 –......
Nickel salt, double, bbl., lb	.13¼– .13½	.13¼– .13½	.13 – .13½
Orange mineral, csk., lb	.11¼–......	.11¼–......	.10¼–......
Phosphorus, red, cases, lb	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb	.09½– .10	.09½– .10	.08½– .09
Carbonate, 80–85%, calc. csk., lb	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb	.10 – .12	.10 – .12	.10 – .12
Hydroxide (c'stic potash) dr., lb.	.07 – .07¼	.07 – .07¼	.07 – .07¼
Muriate, 60% bags, unit	.53½–......	.53½–......	.53½–......
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb	.19½– .20	.19½– .20	.18½– .19
Prussiate, yellow, casks, lb	.17 – .18	.17 – .18	.15 – .16
Sal ammoniac, white, casks, lb	.0515– .06	.0515– .06	.05½– .06
Salsoda, bbl., cwt	1.60 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	17.00 –......	17.00 –......	23.00 –......
Soda ash, light, 58%, bags, contract, cwt	1.05 –......	1.05 –......	1.05 –......
Dense, bags, cwt	1.10 –......	1.10 –......	1.10 –......
Soda, caustic, 76%, solid, drums, cwt	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, works, bbl., lb	.04½– .06	.04½– .06	.04 – .05
Bicarbonate, bbl., cwt	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb	.07¾– .08	.07¾– .08	.06¾– .07
Bisulphate, bulk, ton	16.00 –17.00	16.00 –17.00	15.00 –16.00
Bisulphite, bbl., lb	.03 – .04	.03 – .04	.03 – .04
Chlorate, kegs, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½
Cyanide, cases, dom., lb	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb	.08 – .09	.07 – .08	.07 – .08
Hyposulphite, bbl., cwt	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt	2.35 – 2.40	2.35 – 2.40	2.35 – 2.40
Nitrate, bulk, cwt	1.47 –......	1.45 –......	1.45 –......
Nitrite, casks, lb	.06¾– .07	.06¾– .07	.06¾– .07
Phosphate, tribasic, bags, lb	2.35 –......	2.35 –......	2.25 –......
Prussiate, yel. drums, lb	.10½– .11	.10½– .11	.10½– .11
Silicate (40° dr.) wks., cwt	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr. lb	.03 – .03½	.02¾– .03	.02¾– .03
Sulphite, crys., bbl., lb	.02¼– .02¼	.02¼– .02½	.02¼– .02½
Sulphur, crude at mine, bulk, ton	16.00 –......	16.00 –......	16.00 –......
Chloride, dr., lb	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb	.07 – .08	.07 – .08	.07 – .07½
Flour, bag, cwt	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb	.55 –......	.55 –......	.51 –......
Crystals, bbl., lb	.39½–......	.39½–......	.39½–......
Zinc, chloride, gran., bbl., lb	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb	.09¼–......	.09¼–......	.08¼–......
Zinc oxide, lead free, bag, lb	.06½–......	.06½–......	.06¼–......
5% lead sulphate, bags, lb	.06⅝–......	.06⅝–......	.06¼–......
Sulphate, bbl., cwt	3.15 – 3.25	3.15 – 3.25	2.75 – 3.00

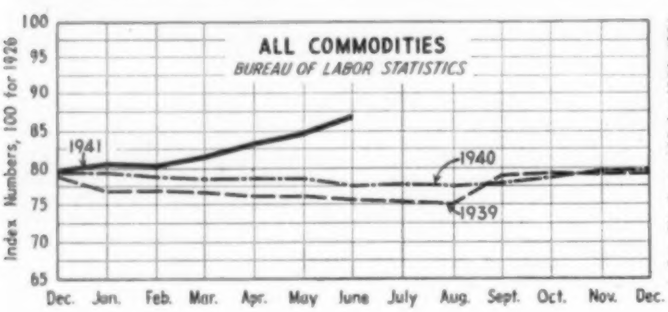
OILS AND FATS

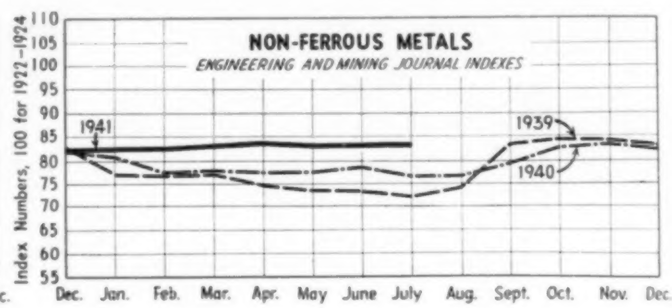
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb	$0.11½–$0.12	$0.11½–$0.12	$0.11 –$0.11½
Chinawood oil, bbl., lb	.33 –......	.32 –......	.25 –......
Coconut oil, Ceylon, tank, N. Y., lb	.07⅝–......	.07 –......	.03¼–......
Corn oil crude, tanks (f.o.b. mill), lb	.12 –......	.12 –......	.05½–......
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.10¾–......	.10½–......	.04¾–......
Linseed oil, raw car lots, bbl., lb	.113–......	.113–......	.088–......
Palm, casks, lb	.07 –......	.06¾–......	.03¾–......
Peanut oil, crude, tanks (mill), lb	.12 –......	.12 –......	.05½–......
Rapeseed oil, refined, bbl., lb	.15½–......	.15 –......	.12 –......
Soya bean, tank, lb	.09¾–......	.10 –......	.04½–......
Sulphur (olive foots), bbl., lb	.16 –......	.16 –......	.08⅝–......
Cod, Newfoundland, bbl., gal	nom.......	nom.......	nom.......
Menhaden, light pressed, bbl., lb	.104–......	.104–......	.071–......
Crude, tanks (f.o.b. factory), gal	.60 –......	.60 –......	.35 –......
Grease, yellow, loose, lb	.07½–......	.07¼–......	.03⅞–......
Oleo stearine, lb	.09½–......	.09½–......	.05⅛–......
Oleo oil, No. 1	.10½–......	.10½–......	.06¼–......
Red oil, distilled, dp.p. bbl., lb	.10½–......	.10½–......	.06½–......
Tallow extra, loose, lb	.08 –......	.07¾–......	.03⅝–......

Chem. & Met.'s Weighted Price Indexes









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.	$0.52 –$0.55	$0.52 –$0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U S.P., dr., lb.	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb.	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S P., kgs., lb.	.54 – .56	.54 – .56	.54 – .56
Benzyl chloride, tech., dr., lb.	.23 – .25	.23 – .25	.23 – .25
Benzol, 90%, tanks, works, gal.	.14 –	.14 –	.15 – .....
Beta-napthol, tech., drums, lb.	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb.	.10½– .10¾	.10½– .10¾	.09½– .10
Cresylic acid, dr., wks., gal.	.76 – .78	.76 – .78	.58 – .60
Diethylaniline, dr., lb.	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb.	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluol, bbl., lb.	.18 – .19	.18 – .19	.15½– .16
Dip oil, 15%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, dr. fob wks., lb.	.70 –	.70 –	....
H-acid, bbl., lb.	.45 – .50	.45 – .55	.45 – .50
Naphthalene, flake, bbl., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Nitrobenzene, dr., lb.	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb.	.47 – .49	.47 – .49	.47 – .49
Phenol, U.S.P., drums, lb.	.12½–	.12½–	.13 – .....
Picric acid, bbl., lb.	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal.	1.70 – 1.80	1.70 – 1.80	1.70 – 1.80
Resorcinol, tech., kegs, lb.	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb.	.33 – .40	.33 – .40	.33 – .40
Solvent naptha, w.w., tanks, gal.	.27 –	.27 –	.27 – .....
Tolidine, bbl., lb.	.86 – .88	.86 – .88	.86 – .88
Toluol, drums, works, gal.	.32 –	.30 –	.30 – .....
Xylol, com, tanks, gal.	.26 –	.26 –	.26 – .....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech, bbl, lb.	.21½– .22	.21½– .22	.11½– .13
China clay, dom., f.o.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb.	.0335– .30	.0335– .30	.028– .30
Prussian blue, bbl., lb.	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb.	.11 – .26	.11 – .26	.10 – .26
Chrome green, bbl., lb	.21½– .30	.21½– .30	.21 – .27
Carmine, red, tins. lb	4.60 – 4.75	4.60 – 4.75	4.85 – 5.00
Para toner, lb.	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb.	3.20 – 3.25	3.20 – 3.25	nom
Chrome yellow, C.P., bbl., lb.	.14½– .15½	.14½– .15½	.14½– .15½
Feldspar, No. 1 (f.o.b.N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.08 – .10	.08 – .10	.06 – .06½
Gum copal Congo, bags, lb.	.09 – .30	.08 – .30	.06 – .30
Manila, bags, lb.	.09 – .15	.09 – .14	.09 – .14
Damar, Batavia, cases, lb.	.10 – .22	.10 – .20	.08 – .24
Kauri, cases, lb.	.18 – .60	.18 – .60	.18½– .60
Kieselguhr (f.o.b. mines), ton.	7.00 –40.00	7.00 –40.00	7.00 –40.00
Magnesite, calc, ton.	65.00 –	65.00 –	65.00 – .....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	nom	nom	.03 – .04
Rosin, H., 100 lb.	3.08 –	2.62 –	2.22 – .....
Turpentine, gal.	.74 –	.51½–	.33¼– .....
Shellac, orange, fine, bags, lb.	.38 –	.38 –	.26 – .....
Bleached, bonedry, bags, lb.	.35 –	.35 –	.25 – .....
T. N Bags, lb.	.28 –	.28 –	.14 – .....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc. 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
200 mesh (f.o b. Ga.), ton.	6.00 – 8.00	6.00 – 8.00	7.50 –11.00

Industrial Notes

THE HERMAN NELSON CORP., Moline, Ill., has purchased the assets and business of the Autovent Fan & Blower Co., Chicago, and will continue it as one of its divisions.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., has made Carleton Reynell general manager of purchases and traffic. Mr. Reynell will be assisted by Frederic W. Thomas and Dean K. Chadbourne.

METAL & THERMIT CORP., New York, constructing a new research laboratory at Woodbridge, N. J. Dr. Lincoln T. Work is directing research activities of the corporation.

ALLIS-CHALMERS CO., Milwaukee, has set up a new department to be known as priorities management. Vice-President L. W. Grothaus will head the department with G. V. Woody as administrator.

EQUIPMENT CORP. OF AMERICA, Chicago, has opened offices in the Hudson Terminal Bldg., New York. John A. Conboy formerly of the Philadelphia office is in charge. C. T. Beebe succeeds Mr. Conboy in Philadelphia.

HERCULES POWDER CO., Wilmington, has acquired the synthetic resin business of John D. Lewis, Providence. This includes the plants at Mansfield, Mass. and at Brunswick, Ga.

THE SOLVAY PROCESS CO., New York, has established a product development section with W. E. Blair as manager and D. H. Ross assistant manager. Headquarters are at 40 Rector St.

VIRGINIA-CAROLINA CHEMICAL CORP., Richmond, has appointed M. J. Simpson manager of the sales office in Montgomery to succeed M. E. Hunter who was recently made asistant general sales manager.

THE FOXBORO CO., Foxboro, Mass., has added Elmer E. Forslind to the sales force and has transferred William W. Nelson from the position of service engineer to sales work.

THE B. F. GOODRICH CO., Akron, mechanical goods division, has formed a new California district with headquarters at 1931 Bay St., Los Angeles. L. L. Horchitz is manager. A branch office has been opened at 355 Brannan St., San Francisco with H. A. Schultz in charge.

NATIONAL OIL PRODUCTS CO., Harrison, N. J., is building a plant at Richmond, Calif., for the production of vitamin-fortified oils and other vitamin products.

KEYSTONE CARBON CO., St. Marys, Pa., has appointed A. T. Carter its representative in upper New York. Mr. Carter will make his headquarters at 36 Richmond St., Rochester.

THE SPARKLER MFG. CO., Chicago, has moved its organization into its own building at Mundelein, Ill., where its production area has been doubled.

Chem & Met New CONSTRUCTION

	Current Projects Proposed Work	Current Projects Contracts	Cumulative 1941 Proposed Work	Cumulative 1941 Contracts
New England	....	....	$2,525,000	$4,291,000
Middle Atlantic	$205,000	$465,000	13,600,000	30,762,000
South	13,100,000	45,965,000	42,793,000	215,140,000
Middle West	540,000	150,000	4,365,000	87,358,000
West of Mississippi	21,125,000	5,525,000	32,305,000	44,616,000
Far West	185,000	14,180,000	1,682,000	30,938,000
Canada	1,122,000	1,000,000	1,972,000	1,935,000
Total	$36,277,000	$67,285,000	$99,242,000	$415,040,000

PROPOSED WORK

Alabama—War Dept., 20th St. and Constitution Ave., N. W., Wash., D. C., plans to construct an aluminum plant to have a yearly capacity of 100,000,000 lb. in the Muscle Shoals Section (North Alabama). Plant will be operated by Reynolds Metal Co., 7th and Bainbridge Sts., Richmond, Va.

Ark., Stamps—Carter Oil Co., 30 Rockefeller Plaza, New York, N. Y., plans to construct a gas treatment plant. Estimated cost $3,000,000.

Calif., Avon—Tidewater Associated Oil Co., Avon, plans to construct additions to its plant and office. Estimated cost $40,000.

Calif., Berkeley—Cutter Laboratories, 4th and Parker Sts., are having plans prepared by F. E. Barton, Archt., Crocker Bldg., San Francisco, for additions to their laboratories. Estimated cost $45,000.

Calif., Richmond—National Oil Products Co., Essex St., Harrison, N. J., plans to construct the first unit of a chemical and vitamin production plant. Estimated cost $100,000.

Fla., Jacksonville—Filtered Rosin Products, Inc., Beaver St. and Lane Ave., plans to construct a plant to produce filtered and refined spirits, turpentine, rosin and other byproducts from crude pine gum. W. T. Kelly, Vice Pres. Estimated cost $100,000.

Ind., Jeffersonville—Colgate-Palmolive Peet Co., Jeffersonville, plans to construct part 2 story and part 4 story factory buildings for the manufacture of dental and shaving creams. Benjamin A. Pawlik, c/o Company, Engr. Estimated cost $500,000.

Kan., Baxter Springs—War Dept., 20th and Constitution Aves., Wash., D. C., plans to construct an ammonium nitrate plant at the Jayhawk Ordnance Works. Estimated cost $17,700,000.

La., Lake Charles—Mathieson Alkali Works, 60 East 42nd St., New York, N. Y., plans to construct and equip a magnesium plant here to be financed by Defense Plant Corp., Wash., D. C. Estimated cost $12,000,000.

Mich., Detroit—Ditzler Color Co., 8000 West Chicago Blvd., is having plans prepared by Harley & Ellington, Engrs., 1508 Stroh Bldg., for a 3 story addition to its plant. Estimated cost $40,000.

N. J., Rahway—Merck & Co., 126 East Lincoln Rd., will soon award the contract for a 3 story addition to its laboratory, Bldg. No. 50 D. Estimated cost $40,000.

N. J., Hanover—Maltbie Chemical Co., 240 High St., Newark, will soon award the contract for a 1 story, 32x90 ft. chemical manufacturing plant and laboratory. Victor M. Reynal, 360 Main St., East Orange, Archt. Oscar Vogelbach, 650 Rahway Ave., Newark, Engr.

N. Y., Brooklyn—Brillo Manufacturing Co., 205 Water St., is having plans prepared by S. Goldstone, Archt., 285 [illegible] Ave., New York, for altering 4 story warehouse and office building at 183-85 Plymouth St. Estimated cost $40,000.

N. Y., Syracuse—Texas Co., 135 East 42nd St., New York, plans to construct a bulk oil storage plant. Estimated cost $85,000.

S. D., Belle Fourche—Eastern Clay Products, Inc., Eifert, O., plans to construct a bentonite plant to include 16x24 ft. laboratory building, 50x125 ft. and 50x120 ft. factory buildings. Estimated cost $50,000.

Tex., Athens—Harbison-Walker Co., Athens, plans to construct a brick manufacturing plant. Estimated cost $75,000.

Tex., Bowie—Texas Chemurgic Industries, Inc., c/o W. C. Witt, Pres., c/o Southland Life Annex Bldg., Dallas, plans to construct a plant for the manufacture of starch from yam potatoes. Estimated cost $100,000.

Tex., Opelika—Lone Star Gas Co., 1915 Wood St., Dallas, and Shamrock Oil & Gas Co., Amarillo, plans to construct a recycling plant at Opelika. Estimated cost $200,000.

Alta., Calgary—McColl-Frontenac Oil Co., Ltd., 1010 St. Catherine St., W., Montreal, Que., will soon receive bids for the construction of an oil refinery to process oil from Turner Valley and other oil fields. Estimated cost $1,000,000.

Ont., Toronto—McDonald Biochemical Laboratories, Ltd., c/o T. M. Mungovan, 80 Richmond St., W., plans to construct a plant for the manufacture of pharmaceutical and chemical products. Estimated cost $50,000.

Que., Port Alfred—Consolidated Paper Corp., Ltd., Sun Life Bldg., Montreal, Que., will soon receive bids for alterations to its plant here. Estimated cost $72,000.

CONTRACTS AWARDED

Ala., Huntsville—War Dept., 20 St. and Constitution Ave., N.W., Wash., D. C., has awarded the contract for chemical warfare service arsenal, incl. 11 manufacturing plants, 4 chemical loading plants, depot, plant storage, laboratory shops, offices, hospital, to C. G. Kershaw Contg. Co., 2212 20 Ave. SS., Birmingham, Ala. at $29,000,000.

Calif., Los Angeles—Los Angeles Drug Co., 1136 San Julian St., has awarded the contract for a 3 story addition to its industrial building to Kemp Bros., 2900 Hyde Park Blvd. Estimated cost $40,000.

Calif., Oakland—Chemicals, Inc., 32nd and Wood Sts., Oakland, has awarded the contract for additions to its plant to H. E. Rahlmann, 251 Kearney St., San Francisco. Estimated cost will exceed $40,000.

Ia., Iowa Falls—Ralston-Purina Co., 835 South 8th St., St. Louis, Mo., has awarded the contract for a soy bean processing plant to Jones & Hettelsater Construction Co., Mutual Bldg., Kansas City, Mo. Estimated cost $325,000.

Ky., Louisville—Reliance Varnish Co., 915 East Kentucky St., has awarded the contract for a plant to J. D. Jennings, 235 East Gaulbert St., Louisville.

La., Sterlington—Commercial Solvents Co., 17 E. 42nd St., New York, N. Y., has awarded the contract for a anhydrous ammonia plant, near here, for War Dept., to M. W. Kellogg Co., 225 Bway., New York, N. Y., at $16,750,000.

Md., Baltimore—Procter & Gamble Co., 1000 Nicholson St., has awarded the contract for three warehouses to H. K. Ferguson & Co., 25 West 43rd St., New York, N. Y. Estimated cost $100,000.

Mich., Pontiac—Baldwin Rubber Co., 366 East South St., has awarded the contract for a 2 story, 95x273 ft. plant to Darin & Armstrong, 2041 Fenkell Ave., Detroit, Mich. Estimated cost $150,000.

N. Y., Buffalo—National Aniline & Chemical Co., 1051 South Park Ave., has awarded the contract for an addition to its plant to Metzger Construction Co., 429 Carlton St. Estimated cost will exceed $40,000.

N. Y., Niagara Falls—R & H Chemical Dept. of E. I. du Pont de Nemours & Co., Inc., Niagara Falls, N. Y., has awarded the contract for a 2 story, 80x90 ft. plant to Laur & Mack, Inc., 1400 College Ave., Niagara Falls. Estimated cost $50,000.

Ore., Portland—Stauffer Chemical Co., 624 California St., San Francisco, Calif., has awarded the contract for a 100x168 ft. plant for the manufacture of sulphate of alumina here to Drake; Wyman & Voss, Fenton Bldg., Portland. Estimated cost $100,000.

Pa., Altoona—Linde Air Products Co., 30 East 42nd St., New York, N. Y., has awarded the contract for substructure for 1 story, 50x100 ft. plant to Moyer Bros., Beale Ave. and 26th St. Total estimated cost $50,000.

Pa., Johnsonburg—Castanea Paper Co., C. G. Gallup, Asst. to Pres. in charge of purchasing, 230 Park Ave., New York, N. Y., has awarded the contract for a 1 story, 70x170 ft. sulphide soda and paper mill to J. Ferguson, 150 Market St., Paterson, N. J. Estimated cost $125,000.

Pa., South Scranton (Scranton P.O.)—Sauquoit Silk Manufacturing Co., 302 Fig St., Scranton, will construct an addition to its plant to be used as a nylon processing unit. Work will be done by separate contracts. Estimated cost $100,000.

Tenn., Memphis—International Cellucotton Products Co., 1356 Riverside Dr., has awarded the contract for a warehouse to Memphis Construction Co., 160 Union Ave., Memphis. Estimated cost $175,000.

Tex., Corpus Christi—American Smelting & Refining Co., 120 Bway., New York, N. Y., has awarded the contract for the construction of an electrolytic zinc refining plant to James Stewart & Co., 230 Park Ave., New York, N. Y. Estimated cost $5,200,000.

Wash., Spokane—Aluminum Co. of America, Gulf Bldg., Pittsburgh, Pa., will construct an aluminum plant here to be operated by the Union Carbide & Carbon Corp., Columbia Blvd., Portland, Ore. Project will be financed by Defense Plant Corp. and will be built with company's own forces. Estimated cost $9,000,000.

Wash., Tacoma—Aluminum Co. of America, Gulf Bldg., Pittsburgh, Pa., will construct and aluminum plant here to be operated by the Olin Corp., Koppers Bldg., Pittsburgh, Pa. Project will be financed by Defense Plant Corp. and will be built with company's own forces. Estimated cost $5,000,000.

Que., Hull—E. B. Eddy Co., Ltd., Bridge St., has awarded the contract for an acid plant to Foundation Co. of Canada, Ltd., 1538 Sherbrooke St., W., Montreal. Estimated Cost $1,000,000.